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SECOND REPORT OF CANADA UNDER THE 1987 PROTOCOL TO THE 1978 GREAT LAKES WATER QUALITY AGREEMENT

TECHNICAL SUMMARY

Prepared by: **The Government of Canada and the Government of the Province of Ontario under The 1986 Canada-Ontario Agreement Respecting Great Lakes Water Quality**

December 1990

92-01749/

"The Parties [Canada and Ontario] agree that their long term strategic objective is to restore and protect the chemical, physical and biological integrity of the Great Lakes Basin Ecosystem as a multi-use resource whose base provides the setting and foundation for social development and economic investment."

Article II, Strategic Objective, Canada-Ontario Agreement

This report is dedicated to all citizens of the Great Lakes Basin who have contributed in the past and who will contribute in the future to the preservation and restoration of this vital resource for present and future generations.

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Introduction

The governments of Canada and the United States entered into Agreements in 1972 and 1978 to restore and enhance water quality in the Great Lakes. In 1987, the two countries signed a Protocol amending the Great Lakes Water Quality Agreement (GLWQA) of 1978. Their signatures on this Protocol reaffirmed their commitment "to restore and maintain the chemical, physical, and biological integrity of the waters of the Great Lakes Basin Ecosystem".

The GLWQA provides a unique framework that promotes binational, multi-tiered co-operation among Canada, the United States, the Province of Ontario and the eight Great Lakes States. This Agreement also integrates the management of water, land and air. In particular, the Agreement, as amended by the Protocol, seeks to control airborne toxic substances, to develop strategies to remedy the problem of contaminated sediments, to designate and remediate Areas of Concern, to reduce pollution from non-point sources, to protect groundwater and to establish water quality objectives for each of the Great Lakes.

Canada's implementation of the GLWQA is facilitated by a partnership between the federal and provincial governments under the Canada-Ontario Agreement Respecting Great Lakes Water Quality (COA). COA is the formal mechanism by which the Government of Ontario commits to undertake those GLWQA responsibilities which fall within provincial jurisdiction. The implementation of this Agreement is overseen by the COA Board of Review, which is co-chaired by the Federal Department of the Environment and the Provincial Ministry of the Environment. Other members include the Federal Departments of Agriculture, Fisheries and Oceans and the Provincial Ministries of Agriculture and Food, and Natural Resources.

Under the 1978 Great Lakes Water Quality Agreement, the International Joint Commission (IJC) is assigned an evaluative role. The IJC is required to make a full report to the federal governments of Canada and the U.S. on a biennial basis. The 1987 Protocol requires that the two Parties (Canada and the United States), in turn, report biennially to the International Joint Commission on the progress of implementation of the specific Annexes of the Agreement.

In fulfilling this role, the IJC has listed 36 recommendations in its *Fourth Biennial Report* and 27 in its *Fifth Biennial Report*. Within the framework of meeting the requirements of the Protocol, both Canada and the U.S. have agreed to respond publicly to these recommendations within their respective reports.

The *First Report of Canada*, released in February, 1989, highlighted initial progress in implementing the 1987 Protocol. During the last two years, a number of new and challenging initiatives have been developed and undertaken in partnership with various federal and provincial government agencies, regional and municipal governments, industry representatives, non-governmental organizations and individual citizens.

This document constitutes the *Second Report of Canada* under the 1987 Protocol and has been written jointly by Canada and Ontario under the auspices of COA. The report has been organized into two parts. The first part of the report, entitled *Issues Overview*, presents an overview of issues that Canada and Ontario have been involved with during the reporting period of January 1, 1989 to December 31, 1990. The second part, represented by this *Technical Summary*, provides a more detailed description of activities undertaken to meet the requirements of the specific Annexes of the 1987 Protocol to the 1978 Canada - U.S. Great Lakes Water Quality Agreement. Canada's progress and its response to the IJC's recommendations are also provided within the context of this report.

The Government of Canada and the Province of Ontario are proud to be part of the co-operative efforts under way to restore, enhance and protect one the world's most precious and unique global treasures – the Great Lakes.

Institutional Framework

Regulatory Frameworks:

In 1964, Canada and the United States requested that the International Joint Commission (IJC) investigate the increasing evidence of pollution in the lower Great Lakes. The IJC concluded that the lower Lakes were suffering from eutrophication (nutrient enrichment) and recommended that immediate action be taken.

In 1972, the IJC's recommendations were embodied in the first Canada-U.S. Great Lakes Water Quality Agreement. While the objective of the 1972 Agreement was to minimize eutrophication problems, updated Agreements have reflected the importance of the complete Great Lakes ecosystem, as well as an emphasis on toxic substances.

The Interdepartmental Committee on Water

At the time of the 1972 Agreement, Great Lakes activities were not co-ordinated through any mechanism other than the Interdepartmental Committee on Water (ICW). This Committee was the main co-ordinating body for water matters within the federal government. Created in 1968, the ICW consisted of officials from some twenty federal departments and agencies. At present, it is chaired by the Assistant Deputy Minister of the Environmental Conservation Service. The ICW provides a forum for discussion among representatives of the various federal agencies concerned with water. Terms of reference, revised in 1987, indicate that the ICW "shall review policies and programs of federal departments and assess their support for federal water policies; reconcile policy positions of federal departments; promote a co-ordinated federal approach; and recommend as appropriate amendments or additions to federal water policy."

The Great Lakes Working Group

In order to implement the 1972 Agreement, the ICW convened an ad-hoc task force to compile an annual request to Treasury Board to implement the 1972 Agreement requirements. In response to proposed requirements for implementing the 1978 Great Lakes Water Quality Agreement, the Treasury Board indicated that it would not provide further resources without a co-ordinated management scheme. To co-ordinate the federal activities in implementing GLWQA requirements in response to the Treasury Board's request, the ICW established the Great Lakes Working Group. This working group, consisting of senior officials from six federal departments and chaired by the Department of the Environment (DOE), is responsible for the federal requirements identified in the Great Lakes Water Quality Agreement.

The Great Lakes Working Group reports to the Interdepartmental Committee on Water on the progress and disposition of the funds defined by the Treasury Board and co-ordinates the annual work plans of participating departments to ensure federal implementation of the Agreement requirements. The Working Group meets regularly to agree on priorities to integrate efforts where possible, and to formulate a co-ordinated federal response to various issues when required.

The participating federal agencies are:

- Environment Canada (DOE)
- Health and Welfare Canada (HWC)
- Fisheries and Oceans (DFO)
- Public Works Canada (PWC)
- Agriculture Canada (Ag Can)
- Transport Canada (DOT)

The 1987 Protocol

The 1978 Great Lakes Water Quality Agreement between Canada and the United States, as amended by a Protocol in 1987, retains its central role in guiding government actions to clean up the Lakes. Under this Agreement, the Parties state that it is their purpose "to restore and maintain the chemical, physical and biological integrity of the waters of the Great Lakes Basin Ecosystem." The Agreement has proven to be an effective tool in focusing and co-ordinating government action on both sides of the border.

The 1987 Protocol to the Great Lakes Water Quality Agreement recognizes the need for existing programs to be extended and stepped up, and for new programs to be added. It expresses the Parties' renewed commitment to pursuing the objective of virtually eliminating persistent toxic substances from the ecosystem. It also addresses the current concerns of governments and of an actively involved public. New provisions cover:

- the cleanup of long-standing severely polluted areas (Areas of Concern);

- lakewide management plans;
- contaminated sediments;
- land runoff (pollution from non-point sources);
- airborne toxics;
- effects on human health; and
- new ecosystem and water quality objectives.

The Great Lakes Action Plan (GLAP)

In response to the challenge posed by the demands of the 1987 Protocol, the Canadian federal government initiated, in 1989, a five year $125 million Great Lakes Action Plan to clean up the Great Lakes.

The Action Plan has three components: a $55 million Cleanup Fund; a $50 million Preservation Program; and a $20 million Health Effects Program. Programs under the Great Lakes Action Plan are co-ordinated through the federal Great Lakes Working Group, which is chaired by the Department of the Environment. Six federal agencies contribute to the Action Plan: Environment Canada, Fisheries and Oceans Canada, Health and Welfare Canada, Agriculture Canada, Transport Canada and Public Works Canada.

Each department of the Great Lakes Working Group has a role to play in implementing the Plan. Programs are carefully co-ordinated with the provincial government and the private sector, as well as with the St. Lawrence Centre, itself a focal point for cleanup of the St. Lawrence, which is of course the downstream recipient of Great Lakes waters.

The Action Plan is not in itself the ultimate solution, it is one of several steps in the right direction. It serves as a stimulus to the corporate sector, private citizens and other government agencies, including the U.S. federal government, to contribute to the overall cleanup efforts being made by the Canadian federal government.

Provision is made for public involvement in each of the three components of the Great Lakes Action Plan. Local Remedial Action Plan (RAP) Public Advisory Committees collaborate with RAP Teams to develop and implement Cleanup Fund projects. The Health Effects Program of the Great Lakes Action Plan also includes many public involvement mechanisms.

External input into the Preservation Program, and into overall planning of the Action Plan, comes primarily through a Great Lakes Action Plan Strategic Advisory Committee. This Committee is composed of key community members from labour, industry, citizens' groups and academia. It meets approximately five times per year, one of which is a full-day workshop to integrate advice into the annual workplanning exercise. Committee members, while not strictly "representatives" of the sector from which they are drawn, do bring their own unique perspective to the planning process and this helps to clarify public expectations and facilitate effective planning.

The Canada-Ontario Agreement Respecting Great Lakes Water Quality

Constitutionally, environmental quality in Canada is a shared responsibility between the federal and provincial governments. As a result it became obvious that co-operative efforts were needed to ensure that federal-provincial programs were delivered in a well- integrated and fully co-operative fashion. To this end, Canada and Ontario concluded a federal-provincial agreement, the Canada-Ontario Agreement Respecting Great Lakes Water Quality (COA).

The COA allows for greater co-operation between governments including information transfer, co-ordination of programs and the sharing of work and costs. The COA was originally signed in 1971, and later renewed and revised in 1976, 1982 and 1986. The Agreement fulfils Canada's international commitments under the Great Lakes Water Quality Agreement. It serves to co-ordinate government programs involved with the surveillance and monitoring of pollution levels and the development of new methods of pollution control. The focus of the original Agreement was the reduction of phosphorus in municipal sewage and improvements in urban drainage. The focus has since shifted to the control of toxic chemicals and runoff from both urban and agricultural lands.

Environment Canada (federal co-chair), the Ontario Ministry of the Environment (provincial co-chair), Fisheries and Oceans Canada, the Ontario Ministry of Natural Resources, Agriculture Canada, the Ontario Ministry of Agriculture and Food, and the Ontario Ministry of Intergovernmental Affairs are signatories to the Canada-Ontario Agreement and participate in activities through membership on the COA Board of Review and its constituent subcommittees.

ANNEX 1:
Specific Objectives

The 1987 protocol to the 1978 Great Lakes Water Quality Agreement commits the Parties to the development of Specific and Ecosystem Objectives. Specific objectives are the yardsticks by which environmental problems in the Great Lakes system are defined and progress is measured. They represent minimum levels of water quality desired in the boundary waters of the Great Lakes in order to restore the beneficial uses or levels of environmental quality identified in the Great Lakes Water Quality Agreement. Specific objectives are intended to be protective of the most sensitive life stage of the most sensitive species within the Great Lakes and are therefore not intended to preclude the establishment of more stringent requirements. There are many factors that affect the health of the ecosystems, however, and specific objectives are limited to the impact of particular substances on particular receptors in the environment. Ecosystem objectives allow a more comprehensive and integrated measure of ecosystem health by specifying the desired ecological attributes of a given system.

According to the provisions of Annex 1 of the Protocol, common specific and ecosystem objectives are developed jointly by Canada and the United States in consultation with the provincial governments and the public. To respond to these requirements, the Parties established the Binational Objectives Development Committee which, in turn, created the Chemical Objectives Work Group and the Ecosystem Objectives Work Group. These groups are responsible for the following tasks:

(a) developing standard methods to determine whether a substance is present or has the potential of being discharged into the Great Lakes and has actual or potential acute or chronic toxic effects on aquatic, terrestrial or human life;

(b) by using the standard methods agreed to by the Parties, compiling and maintaining three lists of substances to guide the Parties, state and provincial governments or the International Joint Commission in proposing new Specific Objectives for substances of concern;

(c) recommending to the Parties, for their consideration, new or modified specific objectives;

(d) recommending to the Parties, for their consideration, action levels to protect human health based on multi-media exposure and the interactive effects of toxic substances; and

(e) developing ecosystem objectives and ecosystem health indicators, to ensure the restoration and/or maintenance of chemical, physical and biological integrity of the Great Lakes Basin Ecosystem.

Ecosystem Objectives

The initial focus of the binational Ecosystem Objectives Work Group was on developing ecosystem objectives for Lake Ontario in conjunction with the Lake Ontario Toxics Management Plan. The development of ecosystem objectives for Lake Ontario has three components. The first is a statement of goals, which reflect societal values in and around Lake Ontario. The second is a set of ecosystem objectives for various components of the ecosystem that would ensure attainment of these goals. Finally, one or more indicators, which must be measurable and quantitative, will be selected for measuring progress towards each objective.

In March, 1990, workshop participants representing fishing interests, industry, academia, government and environmental groups developed three goals and five ecosystem objectives for Lake Ontario as follows:

Goals

1) The Lake Ontario ecosystem should be maintained and as necessary restored or enhanced to support self-reproducing diverse biological communities.

2) The presence of contaminants shall not limit the use of fish, wildlife and waters of the Lake Ontario Basin by humans and shall not cause adverse health effects in plants and animals.

3) We as a society shall recognize our capacity to cause great changes in the ecosystem and we shall conduct our activities with responsible stewardship for the Lake Ontario Basin.

Ecosystem Objectives

1. **Aquatic Communities**

The waters of Lake Ontario shall support diverse healthy, reproducing and self-sustaining communities in dynamic equilibrium, with an emphasis on native species. This objective will be measured by the selection

of attributes for a population of a large predator fish species or community assemblage and components of a benthic community. Separate targets for the nearshore and offshore will be established.

2. **Wildlife**

The perpetuation of a healthy, diverse and self-sustaining wildlife community that utilizes the lake for habitat and/or food shall be ensured by attaining and sustaining the waters, coastal wetlands and upland habitats of the Lake Ontario Basin in sufficient quality and quantity. Candidate indicators for this objective are bald eagle, osprey, cormorant, gull, snapping turtle and mink populations.

3. **Human Health**

The waters, plants and animals of Lake Ontario shall be free from contaminants and organisms resulting from human activities at levels that affect human health or aesthetic factors such as tainting, odour and turbidity.

Preliminary work has defined the approach to be used for indicator selection and several indicators have been proposed including contaminant analysis in fish used for human consumption, bacterial monitoring of recreational beaches, and human health studies. Ongoing research in epidemiology and biomarkers carried out by the Department of National Health and Welfare will evaluate other potential human health indicators.

4. **Habitat**

Lake Ontario offshore and nearshore zones and surrounding tributary, wetland and upland habitats shall be of sufficient quality and quantity to support eco system objectives for health, productivity and distribution of plants and animals in and adjacent to Lake Ontario. Development of indicators will be specific to a minimum number of acres of suitable habitat such as wetlands. This will require an initial and continuing inventory.

5. **Stewardship**

Human activities and decisions shall embrace environmental ethics and a commitment to responsible stewardship. This is perhaps the most difficult, tenuous and novel of the proposed objectives. Quantifiable indicators such as the proportion of profit/budget of a company spent on effluent control, the number of courses offered on environment in schools, or the enrolment in environmental studies could be employed.

Standard Methods and Lists of Substances

Also falling into the category of objectives development is the task of establishing standard methods for evaluating chemicals so that they can be classified and placed on the appropriate priority list within the Great Lakes Water Quality Agreement. The Chemical Objectives Work Group, established under the Binational Objectives Development Committee, has made considerable progress in fulfilling these requirements. Through consultation and co-operation, the Parties have developed standard methods for the compilation and maintenance of lists of substances of concern for the objective development consideration. These Standard Methods, which have been reviewed by the public, determine those substances believed to have acute or chronic toxic effects on aquatic or terrestrial biota and are believed to be present in, or have the potential of being discharged to, the Great Lakes System. These Standard Methods take into consideration acute or chronic toxic effects, carcinogenicity, teratogenicity, mutagenicity, bioaccumulation and environmental persistence.

List 1, as required under Annex 1, paragraph 2(c), details those substances believed to be present within the water, sediment or biota of the Great Lakes System and believed, singly or in synergistic or additive combination with another substance to have acute or chronic toxic effects on aquatic, animal or human life. The 1989 Annex 1 List 1, which will be reviewed and updated annually, consists of 162 compounds, including 24 PCB Arochlor mixtures or congeners, 5 chlorinated dioxin and 5 chlorinated furan isomers. The Great Lakes Water Quality Agreement sets specific objectives limiting concentrations in lake water for 57 of these 162 compounds, since many specific objectives are applicable to groups of compounds. For example, the 24 PCB Arochlor mixtures and congeners in List 1 are considered as total PCBs in the Agreement. The remaining 105 compounds will be the focus of recommendations for incorporation of new or modified specific objectives into the Agreement.

Environmental and health agencies within the Great Lakes Basin operate under different mandates and legislation, hence there are a variety of guidelines, criteria, objectives, rules and standards being used by the various Great Lakes jurisdictions. As one of the responsibilities of the Parties is to recommend new or revised specific objectives for adoption in the Agreement, the Chemical Objectives Work Group has compiled an inventory of these very limits. This inventory revealed that many of the 105 remaining compounds in List 1 are currently covered by numerical limits of various agencies. However, since the procedures used to derive these limits differed between agencies (and may not fulfil the intent of the Agreement, i.e., protection of the most

sensitive life stage of the most sensitive species), it was considered necessary to develop a Protocol for the Review and Adoption of Chemical Specific Objectives for the Great Lakes Water Quality Agreement. This Protocol, which is currently under development, outlines the minimum qualifying requirements that must be met for an agency's objective (or criteria , etc.) to be considered for adoption as a specific objective under the GLWQA. Upon reaching a consensus for this Protocol, and after undergoing public review, the process of recommending specific objectives for chemicals in the Great Lakes will begin.

Great Lakes Water Quality Agreement Annex 1 List No.1

Annex 1 List No. 1 consists of all substances 1) believed to be present within the water, sediment or aquatic biota of the Great Lakes System, and 2) believed to have acute or chronic toxic effects on aquatic or terrestrial biota, including humans, singly or in synergistic or additive combination with another substance.

CHEMICAL NAME

- Acenapthene
- Alochlor
- Aldrin *
- Antimony
- Arsenic *
- Atrazine
- Barium
- Benzene
- Benz(a)anthracene
- Benzo(a)pyrene
- Benzo(b)fluoranthene
- Benzo(k)fluoranthene
- Benzo(g,h,i)perylene
- Beryllium
- Bis(2-ethylhexyl)phthalate *
- Bromodichloromethane
- Butylate
- Butylbenzylphthalate *
- Cadmium *
- Carbofuran
- Carbon disulfide
- Carbon tetrachloride
- Chlordane *
  - cis-chlordane
  - trans-chlordane
  - oxychlordane
- Chlorobenzene
- Chrlorodibromomethane
- Chloroform
- Chloromethane
- 1-Chloronaphthalene
- Chlorpyrifos
- Chromium *
- Cobalt
- Copper *
- Cyanazine
- Cyanide (anion)
- DDT and metabolites *
  - o,p'-DDT
  - p,p -DDT
  - o,p'-DDD
  - p,p'-DDD
  - o,p'-DDE
  - p,p'-DDE
  - p,p'-DDMU
- Dehydroabietic acid
- Diazinon *
- Dibenzo(a,h)anthracene
- Di-n-butylphthalate *
- Dicamba
- Dichloromethane
- 1,2-Dichlorobenzene
- 1,4-Dichlorobenzene
- 1,1-Dichloroethane
- 1,2-Dichloroethane
- 1,2-Dichloropropane
- 2,4-Dichlorphenoxyacetic acid
- Dieldrin *
- N,N-Dimethylaniline
- Dimethyldisuflide
- Di-n-octylphthalate *
- 2,6-Di-t-butyl-p-cresol (BHT)
- Endosulfan
  - alpha-Endosulfan
  - beta-Endosulfan
  - Endosulfan sulfate
- Endrin *
- Ethion
- Ethylbenzene
- S-Ethyl dipropylthiocarbamate
- Fonophos
- Heptachlor *
- Heptachlor epoxide *
- Heptachlorinated dibenzo-p-dioxins
- Heptachlorinated dibenzofurans
- Hexachlorinated dibenzo-p-dioxins
- Hexachlorinated dibenzofurans
- Hexachlorobenzene
- Hexachloro-1,3-butadiene
- Hexachlorocyclopentadiene
- Hexachloroethane
- Indeno(1,2,3-cd)pyrene
- Lead *
- Lindane (gamma-HCH) *
  - Hexachlorocyclohexane
  - alpha-Hexachlorocyclohexane

beta-Hexachlorocyclohexane
Linuron
Malathion
Mercury *
p,p'-Methoxychlor *
2-Methyl-4-chlorophenoxyacetic acid
2-(2-Methyl-4-chlorphenoxy)-propionic acid
Metolachlor
Metribuzin
Mirex *
10-monoH-mirex
2,8-diH-mirex
photomirex
Naphthalene
Nickel *
n-Nitrosodiphenylamine
Octachlorodibenzo-p-dioxins
Octachlorodibenzofurans
Octachlorostyrene
Pendimethalin
Pentachlorobenzene
Pentachlorodibenzo-p-dioxins
Pentachlordibenzofurans
Pentachlorophenol
Perylene
Phenanthrene
Phenol
Polychlorinated biphenyls *
Arochlor-1232
Arochlor-1242
Arochlor-1248
Arochlor-1254
Arochlor-1260
Arochlor-1262
2,2',3,4,5,5'6-heptachloro-1,1'-biphenyl
hexachloro-1,1'-biphenyls
2,2',3,3',4,4'-hexachloro-1,1'-biphenyl
2,2',3,4,4',5'-hexachloro-1,1'-biphenyl
2,2',3,4,5,5'-hexachloro-1,1'-biphenyl
2,2',4,4',5,5'-hexachloro-1,1'-biphenyl
2,3',4,4',6,6'hexachloro-1,1'-biphenyl
pentachloro-1,1'-biphenyls
2,2',3,4,5'-pentachloro-1,1'-biphenyl
2,2'3,5',6-pentachloro-1,1'-biphenyl
2,2',4,5,5'-pentachloro-1,1'-biphenyl
2,3',4,4',5-pentachloro-1,1'-biphenyl
2,2',3,3',4,4',5,5'-octachloro-1,1'-biphenyl
Tetrachloro-1,1'-biphenyls
2,2',3,5'-tetrachloro-1,1'-biphenyl
2,2',4,5'-tetrachloro-1,1'-biphenyl
2,2',6,6'-tetrachloro-1,1'-biphenyl
2,3',4,4'-tetrachloro-1,1'-biphenyl
2,3,4,5-tetrachloro-1,1'-biphenyl
2,3',4',5-tetrachloro-1,1'-biphenyl
2',3,4-trichloro-1,1''-biphenyl
Pyridine
Selenium *
Silver
Silvex (2,4,5-TP)
Styrene
1,2,3,4-Tetrachlorobenzene
1,2,3,5-Tetrachlorobenzene
1,2,4,5-Tetrachlorobenzene
Tetrachlorodibenzo-p-dioxins
2,3,7,8-Tetrachlorodibenzo-p-dioxins
Tetrachlorodibenzofurans
1,1,2,2-Tetrachlorethane
Tetrachloroethylene
Thallium
Toluene
Toxaphene *
Tribromoethane
1,2,3-Trichlorobenzene
1,1,1-Trichloroethane
1,1,2-Trichloroethane
Trichloroethylene
2,4,5-Trichlorophenol
2,4,6-Trichlorophenol
2,4,5-Trichlorophenoxyacetic acid (2,4,5-T)
2,4,5-Trichlorotoluene
Trifluralin
Uranium
Xylenes
o-Xylene
m-Xylene
p-Xylene

* Indicates those substances for which there are Specific Objectives given in the Great Lakes Water Quality Agreement.

ANNEX 2:
Remedial Action Plans and Lakewide Management Plans

The Development of Remedial Action Plans

In 1985, the IJC's Great Lakes Water Quality Board identified 42 Areas of Concern (AOC) around the Great Lakes. Of these, 17 are located in Canada, including 12 in Canadian waters and five which are shared with the United States on connecting river systems (refer to the overivew map of the Great Lakes Areas of Concern). A 43rd site, Presque Isle Bay in Pennsylvania, has been proposed for designation as an AOC.

Subsequent to the Board's 1985 report, Canada and Ontario committed themselves under the Canada-Ontario Agreement Respecting Great Lakes Water Quality to joint development and implementation of Remedial Action Plans (RAPs) for the Canadian Areas of Concern. RAPs are being developed by 17 RAP Teams, composed of representatives of federal and provincial agencies, under the direction of a COA RAP Steering Committee and in close consultation with the public. (Please refer to the illustration "Remedial Action Plans: The Process").

Canadian RAPs are being developed in conformity with provisions of the Great Lakes Water Quality Agreement, notably the principles and procedures specified in Annex 2. The COA RAP program emphasizes adoption of a systematic and comprehensive ecosystem approach to restoring and protecting beneficial uses and the area's ability to support aquatic life. An operational definition of the ecosystem approach has been developed by the COA RAP Steering Committee to guide RAP Teams in development. Particular attention has been given to ensuring that the public is consulted on all aspects of the RAP program. Guidelines for public involvement were developed and implemented early in the program and local Public Advisory Committees were established to provide input to generate community awareness and support for the Plans. This awareness and support will be critical for successful implementation of RAPs.

The RAP Steering Committee has commenced a number of program-wide initiatives to support the development of RAPs and the transition to implementation. A working group has developed draft Principles for Delisting Canadian Areas of Concern. These draft Principles are under public review and will provide the policy basis, along with guidelines prepared by the IJC, for development of delisting indicators for each Area of Concern. The indicators are to be developed in consultation with the local public and included in the RAP document. A Sediment Task Force has been established to assist RAP Teams in developing comprehensive contaminated sediment management strategies.

The Ontario Ministry of the Environment has completed an inventory of provincial government programs which may be utilized in RAP implementation and the Steering Committee has commissioned studies of existing and alternative mechanisms for implementation funding and of the current statutory and regulatory basis for RAP implementation. Environment Canada and the Ontario Ministry of the Environment have provided a commitment that public involvement will be continued in the implementation phase of RAPs and are exploring organizational structures whereby ongoing public accountability for implementation will be assured.

The RAP Program is unique in its emphasis on multi-disciplinary and multi-agency co-operation in the design and conduct of technical investigations. Eight federal and provincial agencies are currently represented on the RAP Teams and/or involved in research to support Remedial Action Plans. In addition to Environment Canada and the Ontario Ministry of the Environment, other active agencies include the Federal Departments of Fisheries and Oceans, Agriculture, and Health and Welfare Canada and the Provincial Ministries of Natural Resources, Agriculture and Food, and various conservation authorities. The provision of additional support to federal agencies under the Preservation Fund component of the Great Lakes Action Plan has significantly enhanced the technical work effort in support of RAPs. Federal agencies are supporting approximately 40 technical studies at a cost of about $1.6 million in fiscal year 1990/91. The Ontario Ministry of the Environment is supporting approximately 40 technical studies costing $1.4 million in 1990/91. These investigations are essential in providing a sound scientific basis for the selection of remedial actions involving large expenditures of public and private funds.

In addition to ongoing technical studies, considerable progress has been made in implementing those remedial actions which have clear local support and which can commence immediately. Many of these actions have occurred as an outcome of ongoing public infrastructure development programs or as a component of industrial investment and operational plans. Examples include Windermere Basin Dredging (in progress) and the Toronto Eastern Beaches Retention Tank (in progress).

The Cleanup Fund component of the federal Great Lakes Action Plan commenced project funding in 1990. This $55 million Fund was designed as a portion of the federal contribution to the implementation of Remedial Action Plans (RAPs) for Canada's 17 Areas of Concern (AOCs). The goal of the program is to restore beneficial uses in these AOCs and to work towards their eventual delisting as highly polluted areas. The program is guided by the principle of "polluter pays". Projects are referred to specific RAP Teams and the federal Great Lakes Working Group for review and consultation with the appropriate Public Advisory Committees (PACs). Projects which focus on the prevention of pollution and zero discharge of toxic pollution are integral to cleanup efforts. Depending on the nature of the project, contributing partners can include federal, provincial or municipal agencies, industry, and interest groups.

Priorities for cleanup include the assessment, removal and treatment of contaminated sediments; wastewater technology; habitat rehabilitation; and non-point sources of pollution.

The Cleanup Fund, initiated in 1990, made commitments in fiscal year 1990/91 to projects totalling $2,781,000 in Thunder Bay, Nipigon Bay, St. Marys River, Severn Sound, Collingwood Harbour, St. Clair River, Detroit River, Hamilton Harbour and Metro Toronto and Region. In addition, four projects totalling $1,840,000 are also being funded to develop and demonstrate pollution prevention and cleanup technologies applicable to all AOCs.

The Cleanup Fund also sponsored an international technical workshop in 1990 on urban non-point controls to encourage an exchange of information and views in this critical area.

During 1989 and 1990, twelve Stage I documents were submitted in draft to the RAP Steering Committee, with six final documents subsequently submitted to the IJC for review. It is expected that all remaining Stage I reports will be submitted in 1991 *(Table I)*. Current schedules show three Stage II documents being submitted in 1991, the remainder in 1992. These schedules represent some slippage in relation to those presented in the *First Report of Canada (1988)*.

Although Canada and Ontario are committed to expeditious development of RAPs, the need to ensure proper opportunity for public involvement and to ensure provision of a sound technical basis for decisions will ultimately determine schedules. The target dates for submission of Stage II documents *(Table I)* are largely dependent on the willingness of responsible parties to reach a timely consensus on action. Achieving timely consensus, commitment and funding will be the primary challenges during Stage II development. *Table I* is included on the next page to summarize the target dates for submission to the International Joint Commission of Stage I and Stage II Remedial Action Plans.

RAPs - Key Accomplishments

- A high level of local community awareness and support has been established and sustained for RAPs. The principle of an ecosystem approach to environmental restoration and protection has been embraced by a wide range of stakeholders, providing a common point from which consensus on issues has been achieved. Adoption of this approach in conjunction with a comprehensive program of public involvement represents a significant change from past environmental management practices and provides an opportunity and basis for continuing progress. The RAP program is viewed across North America and abroad as a model for local environmental planning and action.
- The problem definition phase (Stage I) of RAP development is nearing completion. This phase has proven to be more extensive than originally conceived, requiring the investment of substantial government resources in technical investigations and environmental monitoring. The COA RAP program has recognized the importance of a comprehensive assessment of use impairments and has stressed the importance of a thorough understanding and public discussion of problems to be addressed. This understanding, to be supported by ongoing research and analysis, provides the basis for informed decisions on environmental remediation.
- Government agencies working on RAPs have demonstrated that an integrated multi-agency and multi-disciplinary approach to planning is achievable. Although much remains to be done to broaden and deepen the connections amongst agencies, the RAP program has demonstrated that the RAP Team approach stimulates a higher degree of co-ordination amongst agencies, resulting in more effective and efficient use of public resources. Emphasis will be given to fulfilling the

TABLE I.

Canadian Areas Of Concern
Anticipated Schedule of Submissions of Remedial Action Plans
to the International Joint Commission

Area of Concern:	Stage I	Stage II
Thunder Bay	(3 Qtr 91)	(4 Qtr 92)
Nipigon Bay	(3 Qtr 91)	(4 Qtr 92)
Jackfish Bay	(3 Qtr 91)	(4 Qtr 92)
Peninsula Harbour	(3 Qtr 91)	(4 Qtr 92)
St. Marys River	(4 Qtr 91)	being determined
Spanish River	(3 Qtr 91)	(4 Qtr 92)
Severn Sound	May 89	(2 Qtr 92)
Collingwood Harbour	May 89	(2 Qtr 92)
St. Clair River	(4 Qtr 91)	being determined
Detroit River	(3 Qtr 91)	being determined
Wheatley Harbour	(3 Qtr 91)	(1 Qtr 92)
Niagara River	(3 Qtr 91)	(4 Qtr 92)
Hamilton Harbour	Oct 89	(4 Qtr 91)
Metro Toronto	Feb 90	(4 Qtr 92)
Port Hope Harbour	Feb 90	(4 Qtr 91)
Bay of Quinte	Jan 90	(4 Qtr 91)
St. Lawrence River	(3 Qtr 91)	(2 Qtr 92)

* According to Section 4(d) of Annex 2 the Remedial Action Plans shall be submitted to the Commission for review and comment at three stages.

I. When a definition of the problem has been completed;
II. When remedial and regulatory measures are selected; and
III. When monitoring indicates that identified beneficial uses have been restored.

public need for sound factual information on the complex issues of public and environmental health.

- The RAP program has served as a catalyst for the development and dissemination of new approaches and techniques for environmental remediation. The philosophy of "pollution prevention" is being popularized through the RAPs as a prerequisite to ensure the sustainability of derived benefits. Public interest and demands for "soft" as well as "hard" solutions has led to an increased emphasis on public information and education as a tool for achieving RAP objectives. Remedial options currently under consideration by RAP Public Advisory Committees hold promise for influencing corporate and household behaviours and attitudes towards use of the aquatic resource. Through programs such as the federal Great Lakes Cleanup Fund and provincial Environmental Technologies Program, RAP areas are serving as demonstration sites for new technologies and techniques. This is particularly evident in the fields of habitat restoration, combined sewer overflow control, industrial process change, sediment cleanup and phosphorus discharge control.

- The RAP program has drawn additional attention at a local, provincial and federal level to the importance of land-use planning in the restoration and protection of the aquatic resource. Through the RAP process, sources of impairments within Great Lakes Areas of Concern are traced to their origin in tributary watersheds. Land-use within watersheds has a profound influence on water quality in the Great Lakes. In turn, water quality is of critical importance in defining the quality and quantity of shore-based recreational and commercial activities which may be sustained. This interconnection has been highlighted in RAPs to date and will undoubtedly be given further emphasis as RAPs proceed.

- Through the RAP program, human health aspects of pollution and cleanup activities have emerged as important issues. At the request of RAP Teams and PACs - especially in the St. Lawrence River, Hamilton Harbour, St. Clair River and Bay of Quinte Areas of Concern - Health and Welfare

Canada has provided advice on Stage I Reports and Options Discussion Papers. Continuing participation in the review of Remedial Action Plans for Superfund sites in Massena, New York has been important to the St. Lawrence River RAP in order to ensure that the proposed strategies are protective of the health of Canadians. Information packages on health including disease incidence statistics for specific communities and information on federal standards have been compiled to respond to specific needs.

Public Involvement in Remedial Action Plans (RAPS)

The best known model for intensive public involvement in the Great Lakes basin is the RAP program. Under this program, 16 Ontario communities have formed Public Advisory Committees (PAC), three of which are binational. In addition to more than 400 individuals who sit on these Committees, several thousand individuals have asked to be included on mailing lists to receive documentation about Remedial Action Plans as they develop. The Public Advisory Committees, in consultation with others in their community, set the goals towards which remedial measures are directed. They work closely with government, usually meeting monthly, to define problems and find workable solutions. Along with others in the community, they will hold implementors of Remedial Action Plans accountable for their actions.

Remedial Options Discussion Papers have been prepared and released for public review at four sites: Hamilton Harbour, Metro Toronto, Bay of Quinte and Severn Sound. The Bay of Quinte Public Advisory Committee released its report and recommendations in 1990 providing a strong basis for completion of that RAP document in 1991. In 1990, RAP Public Advisory Committees formed a basin-wide Council to provide an information-sharing function on issues of common interest and to liaise with the RAP Steering Committee on policy and program development. The Bay of Quinte and Hamilton Harbour Public Advisory Committees are actively considering an appropriate role and structure for public involvement during the implementation phase. Evidence of the COA commitment to public consultation is the total of $1.1 million allocated by Environment Canada and Ontario Ministry of the Environment to support public involvement and information activities in fiscal year 1990/91.

Success Stories

Fulfilment of RAP goals encompasses a broad range of activities carried out by the private sector, citizen groups and all levels of government. The following summarizes remedial actions, improvements in environmental conditions, and other significant advances related to the attainment of Remedial Action Plan goals and objectives for the 17 Canadian Areas of Concern on the Great Lakes.

Thunder Bay

1. New sludge management practices at Northern Wood Preservers will reduce suspended solids and related toxins.

2. Final effluent from Reichhold Chemicals was directed for treatment in the municipal sewer system in 1988.

3. The last untreated direct sewer discharge to the Kaministiquia River was integrated into the Thunder Bay municipal system in 1989.

4. Interim cleanup of contaminated sediments at the Northern Wood Preservers site took place in 1989.

5. The Great Lakes Cleanup Fund is providing approximately $2 million to fund the restoration of riverine habitat diversity at several degraded sites in Thunder Bay, including McKellar River Wetlands, and the Neebing-McIntyre Floodway.

Nipigon Bay

1. The federal Great Lakes Cleanup Fund is allocating $700,000 for habitat rehabilitation projects and re-establishment of walleye fisheries in Nipigon Bay.

Jackfish Bay

1. Kimberly-Clark Canada Limited has spent $10 million on the construction of expanded secondary effluent treatment lagoons in 1989.

Peninsula Harbour

1. The James River-Marathon Limited mill has begun preliminary studies on the design of a secondary treatment expansion.

2. Public access to the waterfront has been improved by the construction of a concrete launch ramp on James River-Marathon Limited property.

Spanish River

1. In 1983 E.B. Eddy Forest Products Limited implemented secondary treatment at a cost of $10 million. This action has resulted in a marked, reduction in

Biological Oxygen Demand (BOD), loadings and suspended solids to the River. Final mill effluent was also determined to be non-toxic based on standard rainbow trout bioassays.

2. By the fall of 1984 there was a marked increase in the recreational use of the downstream walleye fishery. There have been no reports of fish tainting; these results were confirmed by taste panel evaluations in 1986 and 1989.

3. Benthic studies carried out in 1984, 1986, and 1988 reflected marked improvements in water/sediment quality.

4. Historical issues such as the presence of foam, bark, and fibre in the water and sediments have been insignificant since 1986.

5. Creel census surveys carried out in 1985 and 1987 suggest that the walleye fishery has largely recovered after more than 30 years of environmental degradation.

6. In December, 1988, E.B. Eddy Forest Products Limited switched to the use of high level (55%) chlorine dioxide substitution on their softwood line which reduced the formation of dioxins and dibenzofurans. They also propose to convert their hardwood line to chlorine dioxide in the summer of 1990.

7. In 1989 all waste streams from E.B. Eddy Forest Products Limited, which previously received only primary treatment, were directed to the secondary lagoon.

Severn Sound

1. Studies of localized sediment quality indicate that Severn Sound sediments are essentially free of organic and trace metal contamination.

2. The Shoreline Pollution Control Survey (cottage and boat) was initiated during 1990 with partial funding through the federal Great Lakes Cleanup Fund.

3. The Severn Sound RAP Team has released the document "Severn Sound RAP Interim Phosphorus Control Strategy" calling for the protection of water quality in Penetang Bay through more stringent controls on effluents.

4. The RAP supported the maintenance of the North Simcoe Soil and Crop Improvement Association's no till drill demonstration, resulting in some 400 acres of Severn Sound farmland being converted to no till cropping.

5. Although the walleye catch at Sturgeon Bay is still down, the forage base is good and the growth rates of walleye in the Sound are better than the provincial average.

Collingwood Harbour

1. With phosphorus removal implemented in 1986, effluent from the municipal sewage treatment plant now meets provincial objectives for the upper Great Lakes.

2. Nutrient concentrations in the harbour measured in 1989 and 1990 were substantially lower than in previous surveys. Mean phosphorus concentrations were 25µg/L in 1989 (approaching provincial objectives), and less than 20µg/L in 1990.

3. Discharges of lead from Blue Mountain Pottery to the municipal sewage system were eliminated in 1987.

4. Studies conducted from 1986 to 1989 show that contaminants in sediments are not adversely affecting biota.

5. Improvements to safe handling of fuels in marinas are under way as a result of Public Advisory Committee involvement with marina managers.

6. The Town of Collingwood has initiated a needs study for rehabilitation of its sewer system and a full Environmental Status Report (ESR) for the sewage treatment plant.

7. Over $50 thousand has been allotted for development and construction of an educational facility referred to as "Enviropark".

Wheatley Harbour

1. Point source impacts related to local fish processing operations have been eliminated through improved waste treatment. In order to comply with the Certificate of Approval issued for its 1989 expansion, effluent from Omstead Foods in 1990 must be totally non- toxic to aquatic life. Local septic tank systems have been replaced by a communal sewage system.

2. Muddy Creek wetlands were cleaned of refuse by Environmental Youth Corps students in 1988. This was part of the provincial Students Cleaning Our Rivers (SCOUR) initiative.

3. No dissolved oxygen violations were recorded during routine water quality monitoring in 1990.

4. No beach closures occurred in the Wheatley Harbour area in 1989.

Hamilton Harbour

1. Dredging and disposal of contaminated sediments in Windermere Basin is in progress. The cost to-date of the cleanup, which began in 1988, is $4.5 million. Participants in the cleanup include: Ontario Ministry of the Environment ($1.25 million), Environment Canada ($1.2 million), City of Hamilton ($750,000), Regional Municipality of Hamilton-Wentworth ($750,000), and Hamilton Harbour Commission ($500,000). Capping of the sediments (in consultation with the Canadian Wildlife Service) has begun and will be completed in the spring of 1991.

2. Recycling and treatment improvements at the Dofasco ($15 million) and Stelco steel manufacturing plants were implemented in 1989.

3. Improved chemical treatment of the Woodward Sewage Treatment Plant in 1988 resulted in reduced concentrations (0.4 µg/L) of phosphorus in the effluent. Ammonia and suspended solids concentrations were also significantly reduced.

4. The sand filter installation at the Dundas Sewage Treatment Plant in 1985 resulted in a reduction in phosphorus concentrations to 0.3 µg/L in 1988.

5. The Greenhill Avenue retention basin became operational in 1987 at a cost of $6.5 million. Approval has been given for the Chedoke Creek retention basin, which will be completed in 1992. A third retention tank will be installed as part of a proposed waterfront park. This park is currently undergoing an Environmental Assessment.

Metropolitan Toronto

1. Phase 1 of the Eastern Beaches Retention Tank Project has been completed at a cost of $4.4 million.

2. The Waterfront Water Quality Improvement Program - enhanced provincial funding of municipal pollution abatement activities within Metro Toronto ($39.3 million from 1984-1988) - continued with $1.5 million spent in 1990.

3. The Lakefill Quality Control Program, with fill testing administered by the Metro Toronto and Region Conservation Authority, has been instituted as a $415,000 program funded by user fees.

4. $71 million was spent on improvements to water pollution control plants and infrastructure in 1989 by Metro Toronto and the Province of Ontario.

5. $285,000 was spent on the identification and disconnection of residential sewer cross connections in Metro Toronto in 1988; $266,000 has been budgeted for 1990.

6. $1.7 million is to be spent in 1990 in Metro Toronto and Peel Region on a Household Hazardous Waste collection program.

7. $40,000 was spent in 1989 on SCOUR (Students Cleaning Our Urban Rivers) to improve the aesthetic quality of the rivers.

8. $185,000 was spent funding Metro Toronto Conservation Authority activities along the Don River in 1989.

9. $400,000 in funding was provided in 1989 for RAP research on toxic loading, as well as fish community monitoring and biomonitoring.

Port Hope

1. A small scale in-situ demonstration project of clamshell and hydraulic dredging was undertaken during 1987 and 1988, funded by Atomic Energy of Canada Limited.

2. Atomic Energy of Canada Limited is funding the evaluation of potential disposal facility sites, evaluation of the nature and extent of contaminated wastes, and remedial designs for the removal of these radioactive wastes.

3. On September 30, 1988, the Honourable Marcel Masse authorized the implementation of the first three phases of the process proposed in the report *Opting for Co-operation* for siting a low level radioactive waste management facility in the Province of Ontario.

Bay of Quinte

1. Sediments contaminated with a wood preservative (creosote) were removed by Domtar Wood Preservers after a control order was issued by the Ontario Ministry of the Environment.

2. The Palmer and Dundas Streets Clean-up Committee (Belleville) asked the Bay of Quinte RAP

to assist its efforts to eliminate sewer bypassing and overflows in their area. The City of Belleville responded to the Quinte RAP by initiating a feasibility study and developing a cleanup action plan.

3. Quinte RAP is encouraging an "ecosystem approach". In that regard the Ontario Ministry of the Environment Southeast Region Planning and Approval Unit and the local Quinte municipalities are examining and, where possible, using the recommendations of the Quinte RAP process in evaluating development proposals.

St. Marys River

1. Algoma Steel has spent $28 million on water pollution controls since 1988.

2. In April, 1990, Algoma Steel began construction of a new biological oxidation treatment unit which is expected to be operational by fall 1990.

3. Construction of a waste water filtration plant at Algoma Steel was completed March 30, 1990. Preliminary findings indicate that suspended solids have been significantly reduced. It is expected that a concomitant reduction in contaminants associated with solids will be observed.

St. Clair River

1. Dow Chemical has undertaken approximately $13 million in environmental upgrades since 1985 ($1 million in upgrades is planned for fiscal year 1990/91). These upgrades have resulted in significant reductions in organic loadings and a reduction in the frequency and quantity of spills. Dow Chemical has recently announced a plan which will prevent contaminants from entering the St. Clair River by the year 2000.

2. Esso Petroleum (Imperial Oil) has allocated $50 million in the last five years to improve their wastewater treatment facility in Sarnia.

3. Polysar has allocated $20 million for sewer separation and spill containment.

4. Suncor has upgraded their wastewater plant and established a final lined effluent pond.

5. Shell has allocated $37.5 million to sewer upgrades. Projects include the installation of stormwater tanks and tanks to hold process water.

6. Lambton Industrial Society (Environmental Cooperative) has spent over $1 million per year on monitoring.

Detroit River

1. The Little River Water Pollution Control Plant in Windsor recently completed expansion of its primary and secondary works, thereby reducing the occurrence of bypasses to the Detroit River. The current expansion was completed at a cost of $20 million. Plans are being developed for further improvements at an estimated cost of $8 million.

2. The City of Windsor in conjunction with the Ontario Ministry of the Environment, is currently working on a $40 million project to aid in the connection of 4,000 homes in south Windsor previously on septic tanks which drained directly into Turkey Creek. This is a six year program, initiated in 1987.

3. Suspended solids concentrations in effluent at Ford Motor Company of Canada were reduced from 50 mg/L early in 1988, to less than 20 mg/L by the end of that year. Efforts are ongoing to ensure that effluents come into compliance with the suspended solids requirement of 15 mg/L. In-plant modifications have also occurred to reduce phenol concentrations. Improvements from 0.6 mg/L to 0.1 - 0.3 mg/L have been noted. Additional declines in loadings have been observed in the period from 1985 to 1989 for several parameters including iron, suspended solids and oil, and greases.

4. The City of Windsor and the Ontario Ministry of the Environment have undertaken a comprehensive pollution control plan for the Little River Basin. Further, the City of Windsor is engaged in a sanitary sewer "Needs" study in the Riverside area. The study objectives are to improve drainage, minimize basement flooding and reduce stormwater flows to the Little River Pollution Control Plant.

Niagara River

1. The Angar Ave. Water Pollution Control Plant (WPCP), servicing main Fort Erie, was upgraded to secondary treatment in May 1990. The plant's capacity has been increased from 40 to 98 million litres/day to accommodate increased volume during rainy days.

2. The Stamford WPCP servicing western Fort Erie, was expanded and upgraded to secondary treatment in September, 1985. The effluent loadings from this source have been reduced by 88 per cent between 1981 and 1988.

3. Community wastewater treatment systems were developed in Stevensville in June, 1986, servicing Douglastown and Stevensville; and Queenston in December, 1990, servicing Queenston. A treatment facility is under design for Niagara-on-the-Lake.

4. The Welland River was recognized by World Wildlife Federation as the sole remaining riverine wetland in the Niagara Peninsula, and the Niagara Escarpment was recognized as a unique ecological area by the United Nations.

5. Municipal and industrial point-source dischargers in Ontario have collectively reduced contaminant loadings (metals and nutrients) to the Niagara River by 85 per cent between 1981/82 and 1988/89.

6. The River Road WPCP, servicing the City of Welland, was expanded in 1984 and upgraded to tertiary treatment in September, 1990.

7. The Town of Fort Erie's landfill site sludge lagoons have been phased out completely; sewage sludges are now being transported to an approved facility.

8. Atlas Steels, once Canada's major contributor of toxic substances to the Niagara River, reduced toxic discharges by 87 per cent between 1981/82 and 1988/89.

St. Lawrence River

1. The 1988 expansion and upgrading of the Cornwall sewage treatment plant and sewer system has reduced the number of combined sewer overflow discharges and overflow points.

2. The shutdown of Courtaulds Films in 1989 will significantly reduce total contaminant loadings to the area.

3. Beach closings and algae problems in the Area of Concern were substantially reduced during the summer months of 1990.

RAP Development Progress

The following is an update on progress of development, by Area of Concern, for each of the Canadian and Binational RAPs.

The North Shore of Lake Superior Remedial Action Plans

All four Public Advisory Committees (PACs) have presented their Water Use Goals to the public, have finalized their goals and are ready to enter Stage II of the RAP process.

On March 21-24, 1990, the North Shore of Lake Superior PACs hosted the "Making of a Great Lake Superior" conference. The theme of this conference was water quality in Lake Superior and Remedial Action Plans in the Basin. Attendees included representatives from Canadian and American PACs, industry, the scientific community, environmental groups, the Ontario Ministry of the Environment, Environment Canada, tourism and the public.

Thunder Bay

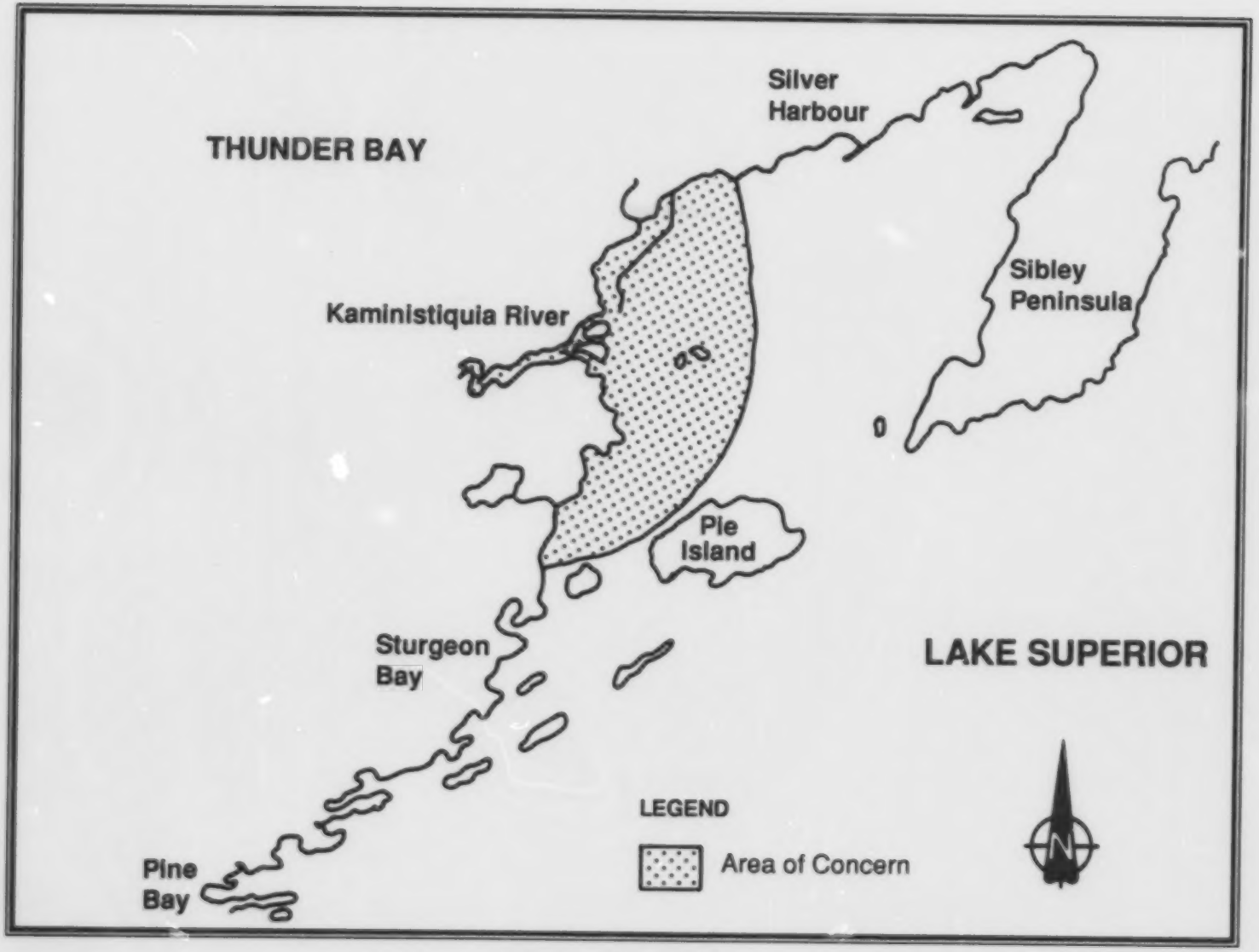
The Stage I Report has been drafted and after review by the Public Advisory Committee, has been forwarded to the RAP Steering Committee. The Public Advisory Committee has drafted its Water Use Goals and presented them to the public in October, 1990.

Publications released in the Remedial Action Plan Technical Report Series since 1988 include: *A Benthos and Substrate Quality Survey of Thunder Bay Harbour in the Vicinity of Northern Wood Preservers, 1972 and 1986; Kaministiquia River Study 1987; Survey of Benthos of the Lower Kaministiquia River, 1989* and *Bacterial Study of Chippewa Beach, Thunder Bay, Ontario, 1989.* Results from a 1988 fish contaminant study were published in *The 1990 Guide to Eating Ontario Sport Fish* (Ontario Ministry of the Environment/Ontario Ministry of Natural Resources). As part of the Remedial Action Plan Technical Report Series, the Ontario Ministry of Natural Resources (MNR) in conjunction with the Ontario Ministry of the Environment have conducted a study of fish behaviour in relation to pulp and paper mill effluent. The report is expected to be completed by 1991. The results from a 1988 MNR study of the salmonid population in the Kaministiquia River will become available in 1991.

The Thunder Bay Public Advisory Committee was asked for their input on a demonstration project between the Municipality of Thunder Bay and the Ontario Ministry of the Environment MISA staff. The Public Advisory Committee was given a presentation on the project which involves identification of industrial and commercial groups discharging wastewater into the City sewer system and identification of the chemical composition of the wastewater. Information gained from this study will be used in developing sewer-use control policies.

Six projects have been approved for funding from the federal Great Lakes Cleanup Fund. These projects are:

1. **McKellar River**
   - creation of spawning and nursery habitat
   - littoral zone rehabilitation



Thunder Bay
Area of Concern

- bottom substrate diversification
- wetland stabilization/reclamation
- improved access, recreational and educational use

2. **Neebing-McIntyre Floodway**
   - create instream cover
   - stabilize river banks
   - establish vegetation
   - enhance recreational use
3. **McVicar Creek**
   - construction of offshore islands
   - creation of wetlands
   - clearing of creek mouth
   - establishment of access
4. **Current River**
   - rehabilitation of spawning habitat
   - fishway construction
5. **Partnership Workshops**
   - problem identification
   - solution proposals
   - partnership identification
   - future remedial action planned
6. **Kaministiquia River Demonstration Project**
   - create instream cover
   - stabilize river banks
   - establish vegetation
   - enhance recreational use
   - remove debris

Public Involvement

The Public Advisory Committee (PAC) held two open houses in October, 1990, to present Water Use Goals to the general public. Approximately 150 people attended the open houses to discuss the goals and look at the displays. These people were given questionnaires regarding the Water Use Goals. In conjunction with the open houses, Water Use Goals and a response sheet were sent to approximately 950 people on the Thunder Bay mailing list.

Those people who commented on the Water Use Goals were generally in agreement with the PAC's work although there were numerous statements which addressed issues which the PAC felt were either too specific for the goals or were already addressed within the goals. Based upon the comments received, the PAC added two goals, addressing odours from water and long range transport, to their list.

The Thunder Bay PAC consists of 22 members. These individuals represent industrial, sport fishing, government, environmental, tourism, academic and recreational groups as well as the general public. The PAC meets on a monthly basis.

Nipigon Bay

The Nipigon Bay Stage I Report is currently being reviewed by the RAP Steering Committee after having been reviewed by the Public Advisory Committee. The PAC completed its proposed Water Use Goals and presented them to the public at open houses in July and September, 1990. The public has expressed support for the Goals through both their responses to questionnaires and through discussion with Public Advisory Committee members.

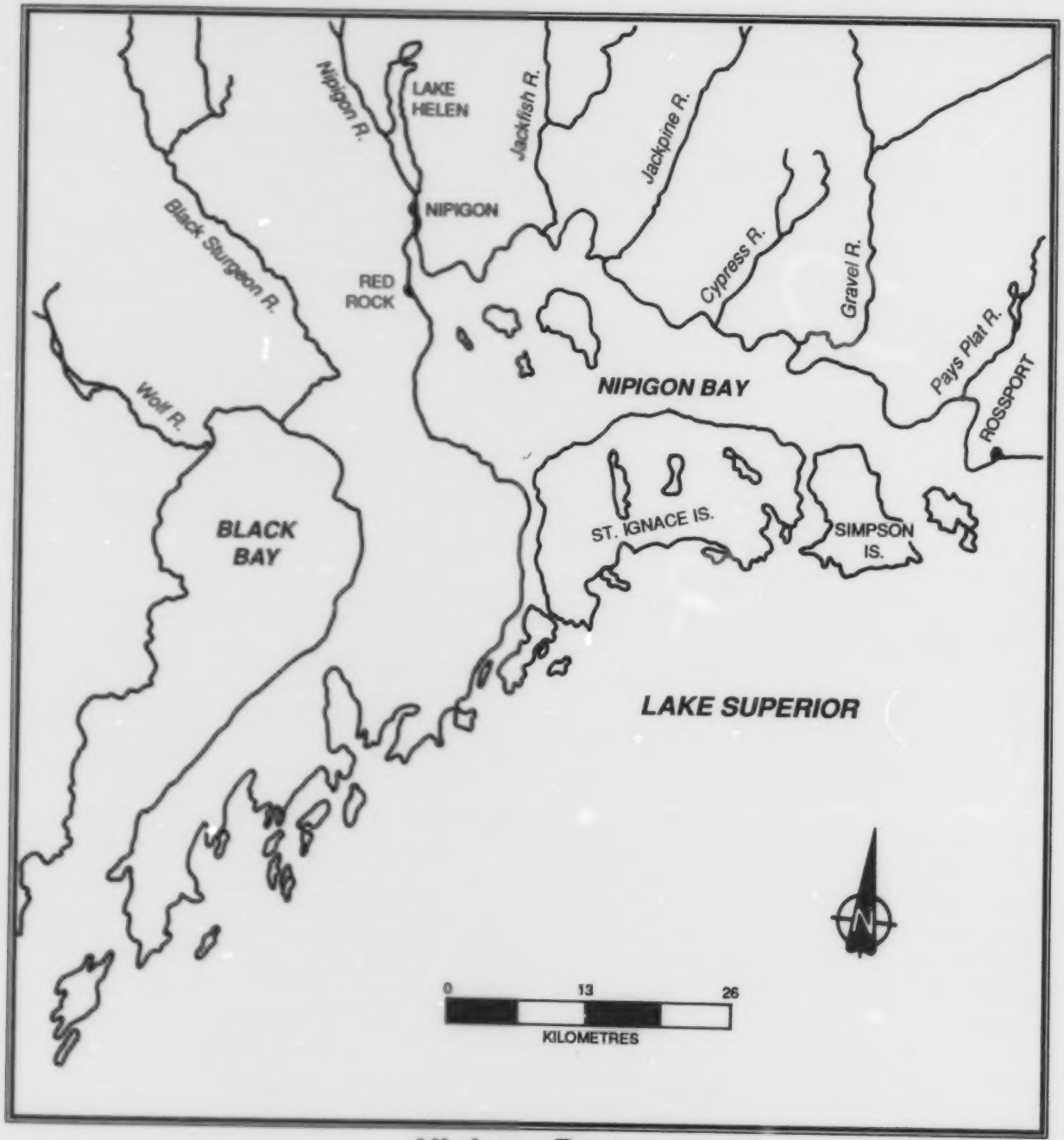
Studies and reports completed in the Nipigon Bay Area of Concern since 1988 include: *The Nipigon River: A Retrospective Summary of Information About the Fish Community* which was published as part of the Remedial Action Plan Technical Report Series in 1990; a 1988 fish contaminants study for which results were released in *The 1990 Guide to Eating Ontario Sport Fish* (Ontario Ministry of the Environment/Ontario Ministry of Natural Resources) and an effluent toxicity study conducted in June, 1990, at Domtar Packaging Inc., a dual project mill located in Red Rock. An interim report on this last study may be available by late 1990.

Domtar Packaging Incorporated is involved in two comprehensive Ontario Ministry of the Environment effluent monitoring programs. First, Ontario Ministry of the Environment Abatement and MISA (Municipal-Industrial Strategy for Abatement) staff regularly collect audit samples from all pulp and paper mills. Second, MISA monitoring regulations require all pulp and paper mills to monitor their effluent from January 1, 1990, to January 1, 1991, prior to the development of effluent limits regulations.

A Control Order issued by the Ontario Ministry of the Environment in 1989 limits BOD, toxicity, suspended solids and organochloride (AOX) levels in mill effluent.

Six projects have also been approved for funding from the federal Great Lakes Cleanup Fund. These projects are:

1. Rehabilitation of walleye stocks in the Nipigon River.
2. Habitat restoration in the lower Nipigon River.
3. Restoration/creation of walleye spawning habitat in the Nipigon River.
4. Habitat restoration at the old mill site in Red Rock.
5. Water management/habitat protection in the Nipigon River.
6. Nipigon environmental interpretive centre.



Nipigon Bay
Area of Concern

Public Involvement

The Nipigon Bay Public Advisory Committee (PAC) presented their Water Use Goals to the public through two information sessions held in conjunction with the Canada Day celebration and the Fall Fishing Festival. At these events, the display was in a high traffic area and convenient to visit. As well, approximately 1500 copies of the goals were distributed in the towns of Red Rock and Nipigon.

The PAC received approximately 15 written responses to the goals. These responses, as well as the verbal comments received during the information sessions, were in support of the goals and the work of the PAC. The PAC modified three of their goals based upon the comments received. The changes were of a relatively minor nature except for the addition of the wording "and other aquatic organisms" after a reference to fish.

The Nipigon Bay PAC consists of 10 members. These individuals represent municipal, industrial, tourism, camping, sport fishing and nature groups as well as the general public. The Nipigon Bay PAC meets on a monthly basis.

Jackfish Bay

The Jackfish Bay Public Advisory Committee has drafted its Water Use Goals and presented them to the public in September, 1990.

The Stage I Report is nearing completion and is targeted for release in the fall of 1991. A report on the benthic community in Jackfish Bay was published in 1990 as a part of the Remedial Action Plan Technical Report Series. Results from the 1988 fish contaminant study were released in *The 1990 Guide to Eating Ontario Sport Fish* (Ontario Ministry of the Environment/ Ontario Ministry of Natural Resources). In July, 1990, an effluent toxicity study was conducted in Jackfish Bay. An interim report may be available by late 1990. Steps are now being taken to find a consultant to develop rehabilitation options for Blackbird Creek. The Blackbird Creek system receives pulp mill effluent from Kimberly-Clark of Canada Limited located in the Town of Terrace Bay. This system drains into Lake Superior at Jackfish Bay.

Kimberly-Clark of Canada Limited brought a secondary treatment facility on line in October, 1989, to comply with an Ontario Ministry of the Environment Control Order and upcoming MISA (Municipal-Industrial Strategy for Abatement) requirements. Kimberly-Clark of Canada Limited has also made a number of process changes that effectively reduce the amount of chlorine used in the bleaching process and thus reduce the loading of persistent toxic contaminants.

A Control Order issued in 1989 limits suspended solid levels, BOD and toxicity to discharged wastewater. An amended Control Order that will also limit chlorinated organic (AOX) levels in discharged wastewater is also anticipated.

An extensive monitoring program is now in place at the mill, as required under the current MISA monitoring regulations. Regular audit samples are also collected by Abatement and MISA staff.

Beak Consultants Ltd. is conducting a sediment study for Blackbird Creek to answer the following questions:

1. Is the Blackbird Creek system contributing to the overall "toxic load" of the water passing through it; if so, where are the sources and how significant are they?
2. If the pollutants were to remain in place, for what period of time would they continue to "contribute" to the system?
3. If we were to assist the "natural" recovery of the system, what remedial options are available and what are the costs associated with each?

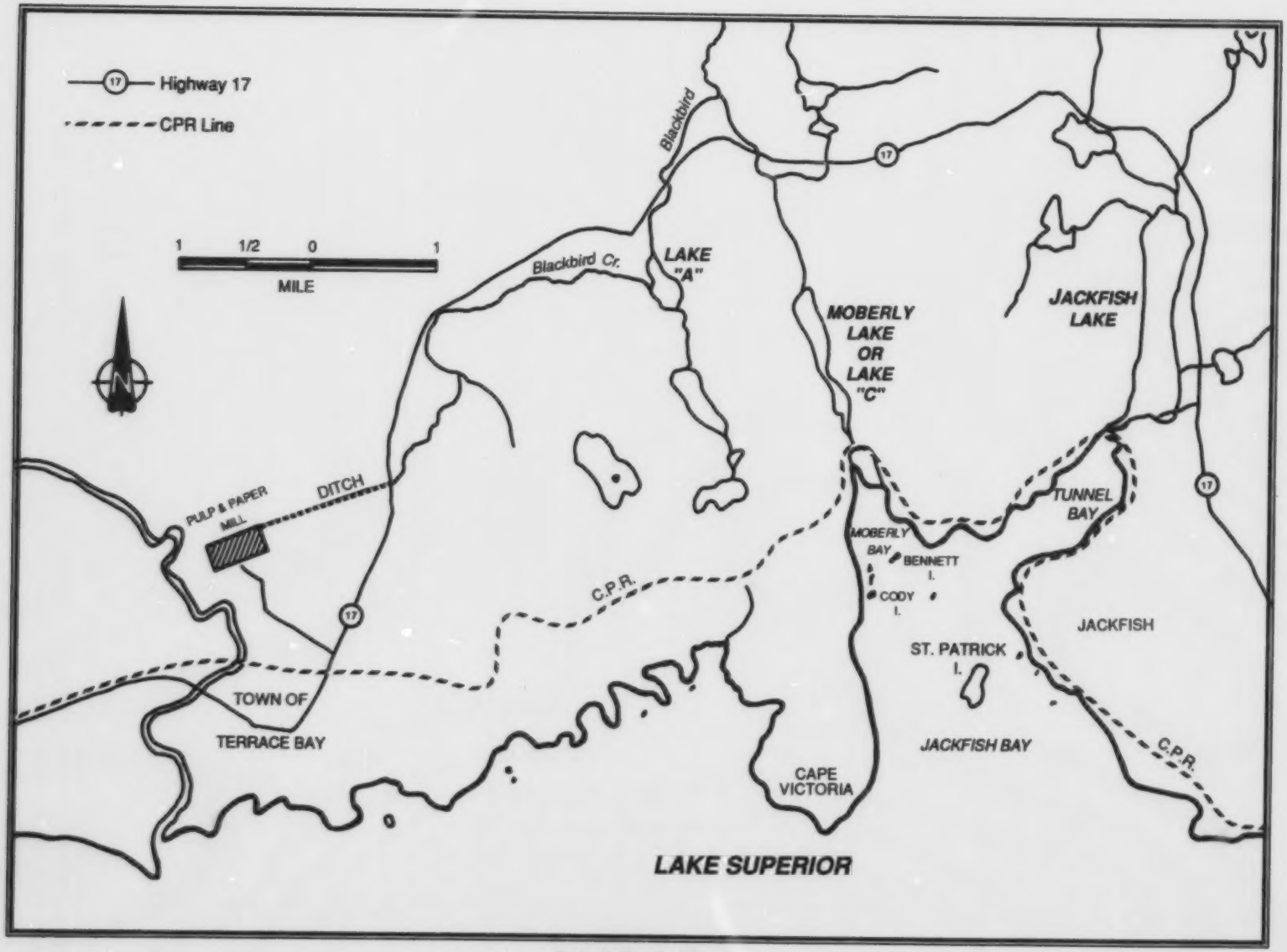
Public Involvement

The Jackfish Bay Public Advisory Committee (PAC) presented their Water Use Goals to the public through an information session held in conjunction with the Terrace Bay Fall Fair. The presentation was very successful attracting many concerned individuals. In addition, the Water Use Goals were mailed to all the citizens of Terrace Bay, Rossport and Schreiber.

The PAC received approximately 10 written responses to the goals. Based upon these responses, the PAC decided to modify three of their Water Use Goals to more accurately reflect the concerns of the community. The modifications included references to the removal of chlorinated organics from point sources and the safety of drinking water from Jackfish Bay and Blackbird Creek.

In general, many of the people in Terrace Bay and Schreiber are not very familiar with the problems associated with Jackfish Bay. This may be due to the inaccessibility of the bay and the fact that it is generally not used or visited by the local population.

The Jackfish Bay PAC consists of 13 individuals. These individuals represent industrial, tourism, union, cottaging, municipal, conservation and recreational interests as well as the general public. The PAC meets on a monthly basis.



Jackfish Bay
Area of Concern

Peninsula Harbour

The *Peninsula Harbour Stage I Report* is being reviewed by the Public Advisory Committee. The Public Advisory Committee prepared its Water Use Goals which were presented to the public at an open house in Marathon in June, 1990. The public responded positively to the Goals through both their discussions with PAC members and through their responses on questionnaires distributed at the open house. Science students at the local high school, as well as grade 7 and 8 students, participated in reviewing the Water Use Goals.

Reports expected to be published in the fall of 1990 or early 1991, as part of the Remedial Action Plan Technical Report Series include: a 1989 benthos study of Peninsula Harbour and *Water Sediment Quality Assessment of Peninsula Harbour, Lake Superior, - Spring, 1984-85* (November, 1990). Results from a 1988 fish contaminant study were published in *The 1990 Guide to Eating Ontario Sport Fish* (Ontario Ministry of the Environment/ Ontario Ministry of Natural Resources). In addition, sediment samples were collected in August, 1990, for bio- monitoring assessment and a preliminary literature review of the potential impact of log booming has been completed.

James River-Marathon Limited, a bleached kraft mill in Marathon, has made in-plant improvements to lower chlorine use in its bleaching process. These improvements have lowered the level of chlorinated organics (AOX) in its wastewater. The company is currently considering an expansion to their operation which would include the installation of a secondary treatment facility for mill effluent. In 1989, James River-Marathon was issued a Control Order by the Ontario Ministry of the Environment which limits BOD, suspended solids and chlorinated organic levels in mill effluent.

The Ontario Ministry of the Environment Abatement and MISA (Municipal-Industrial Strategy for Abatement) staff regularly sample mill effluent. In addition, MISA regulations require all pulp and paper mills to monitor their effluent between January 1, 1990 and January 1, 1991, prior to the development of effluent limit regulations by the Ontario Ministry of the Environment. James River-Marathon is involved in both projects.

At present, the PAC and RAP Team are awaiting results from a sediment study which will assist them in the identification of remedial options for contaminated sediments in the harbour area.

Public Involvement

The Peninsula Harbour Public Advisory Committee (PAC) presented their Water Use Goals through an information booth set up at the Marathon Centre Mall. Approximately 250 sets of Water Use Goals and questionnaires were given out to people passing the display. The PAC received approximately 50 written responses to their goals. Upon review of the comments, the PAC decided to accept the goals without further modification. It appeared that the community of Marathon was generally in support of the PAC's goals and the RAP.

The Peninsula Harbour PAC consists of eight individuals. These individuals represent industrial, recreational, municipal and commercial interests as well as the general public. The PAC meets on a monthly basis.

Spanish River

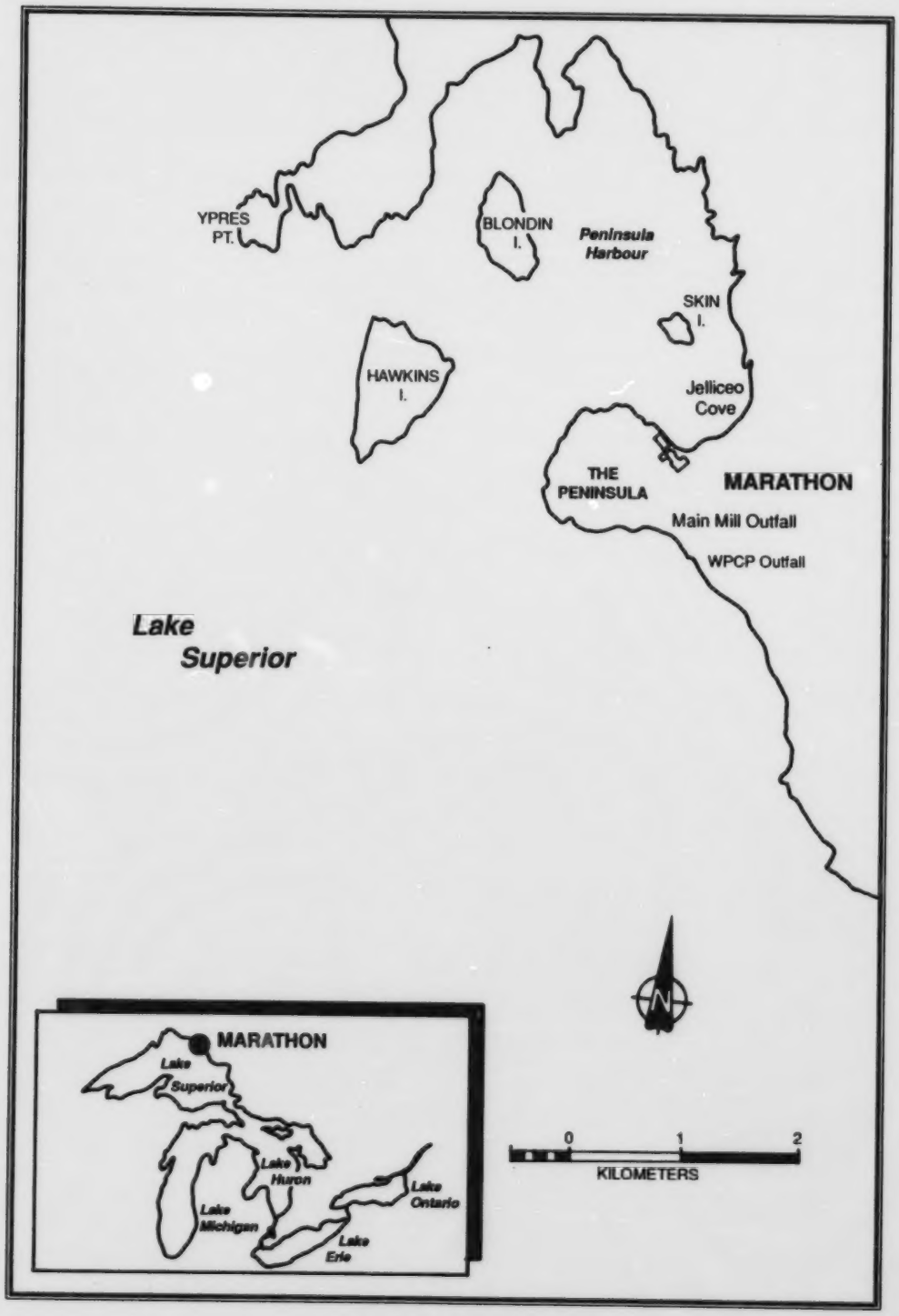
The Stage I Report for the Area of Concern is in its final stages of completion. The report presents the results of the following 1987-90 field studies: benthic and sediment chemistry relationships; radiological dating of sediments; a taste panel evaluation; eutrophication status; bacteriological quality; and sport and juvenile fish contaminant surveys.

A RAP technical report entitled *Spanish River Fish Tainting Evaluation* was released in August, 1990. The results of the 1989 studies, assessing trace contaminant loadings/sediment transport and sediment quality, are currently being written up for release as RAP Technical Reports. These results will be used to assess options for Stage II.

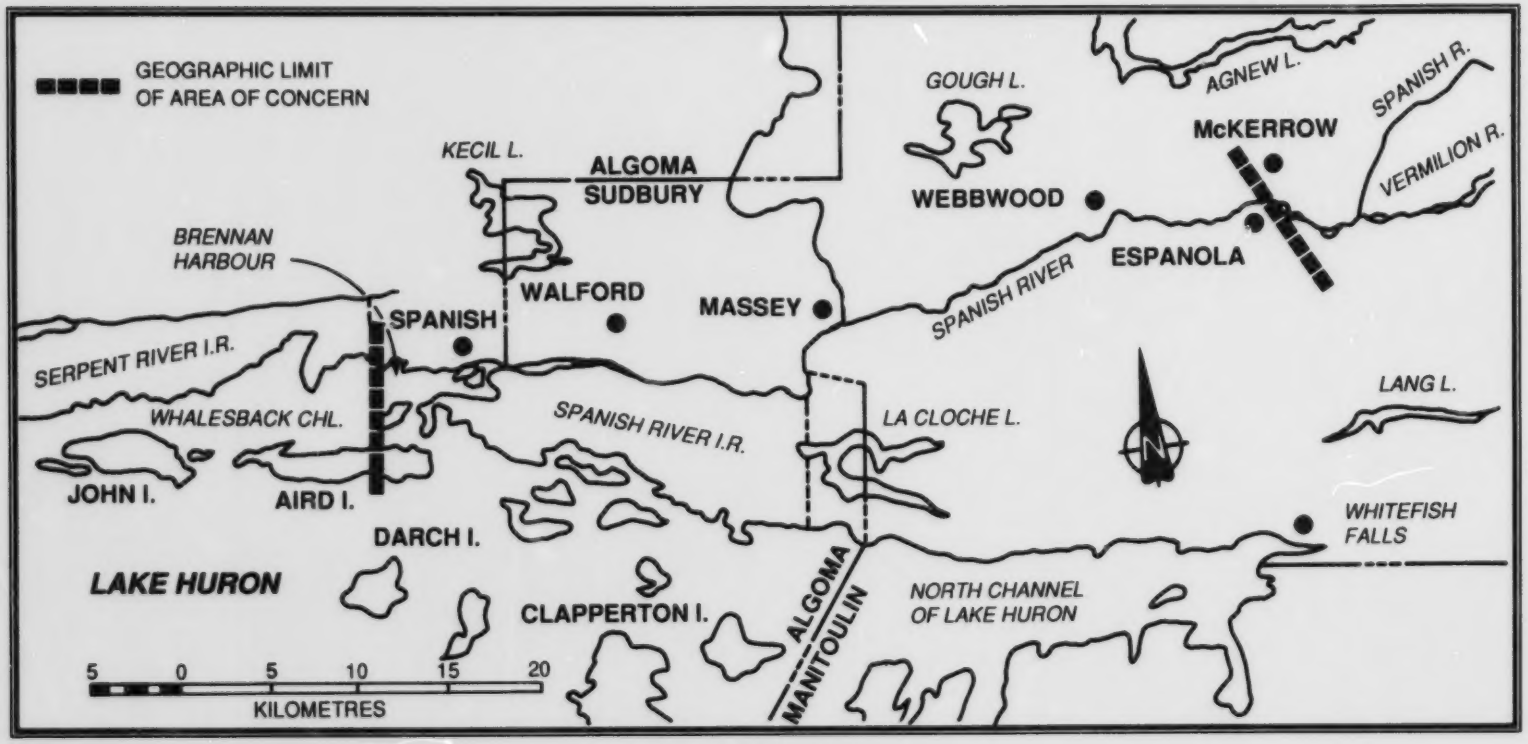
An examination of Spanish River sediments found elevated levels of contaminants, particularly metals. However, there appears to be little effect on benthic fauna populations at the mouth of the river. Results indicate an impoverished benthic fauna, both in number of species and in abundance. The distribution of the benthic fauna appears to reflect organic matter transport and production as governed by the physical environment.

In December, 1988 and August, 1990, E.B. Eddy Forest Products Limited made process changes to their softwood and hardwood lines to increase their use of chlorine dioxide and thus further reduce the formation of chlorinated phenols, dioxins and dibenzofurans. Preliminary trials with hydrogen peroxide have been undertaken to further reduce the use of chlorine in the final bleach stages of the paper making process. Field and laboratory studies are being carried out by the Department of Fisheries and Oceans and the National Water Research Institute to access the acute and chronic impacts of the mill's discharge on the river's fish community.

Historical catch records suggest that four species of fish have either been lost or their population numbers reduced in the AOC. Cause-effect relationships are being



Peninsula Harbour
Area of Concern



Spanish River
Area of Concern

evaluated by reviewing archival aerial photographs and habitat changes.

Reconstruction of the Espanola wastewater treatment plant is currently in the environmental assessment and design phase. Dredging of the Spanish approach channel is currently under way. All dredge spoils from the $400 thousand project will be disposed of on land.

Public Involvement

The PAC for the AOC has continued to meet monthly since January, 1989. The PAC held a goals workshop in September and established a subcommittee to respond to the Province's request for public comment on the MISA Issues Resolution Process. Water Use Goals will be distributed to the public for comment via a second newsletter to be released in winter 1991.

Severn Sound

Eutrophication remains the key environmental problem. The total phosphorus concentration in the Sound has generally increased over the last three years, especially in the south end of Penetanguishene Bay. Nuisance algae conditions continue to interfere with the recreational use of the area.

Studies of the fish communities are continuing. The walleye population is responding to stocking by a local Hunters and Anglers Club. However, the numbers of fish of catchable size are still much lower than the 1970s population. Other work indicates that the nearshore of Severn Sound is used extensively as spawning and nursery areas by a wide variety of fish (35 species).

Sediment bioassessment of selected sites in Severn Sound was carried out during 1990. Preliminary results indicate no toxicity to test organisms.

Point source discharges from municipal sewage plants and non-point sources from storm water, agricultural activities and shoreline development are the major "controllable" sources of phosphorus to the Sound. Although grey water from pleasure craft is estimated to be a small proportion of the overall supply, this source can be significant in localized areas as small sheltered bays.

The large flow of dilute water from Severn River and the exchange between the open waters of Georgian Bay and the main body of Severn Sound are significant factors in flushing the Sound and contribute to the relatively lower total phosphorus concentration in the open Sound. Sheltered bays such as Penetanguishene Bay and Sturgeon Bay have much less flushing and will likely respond more dramatically to abatement of controllable nutrient sources.

Evidence from sediment work and biomonitoring results confirm that Severn Sound does not have active sources of trace contaminants with the exception of a localized area in Midland Bay where a slight elevation in the PCB concentrations of young-of-the-year spottail shiners was found.

The document "Severn Sound Remedial Action Plan: Part 1 Environmental Conditions and Problem Definition" was submitted to the IJC in February, 1989. Following submission of supplemental information on fish and wildlife habitat, the RAP was accepted as achieving Stage I in the formal RAP process.

Public Involvement

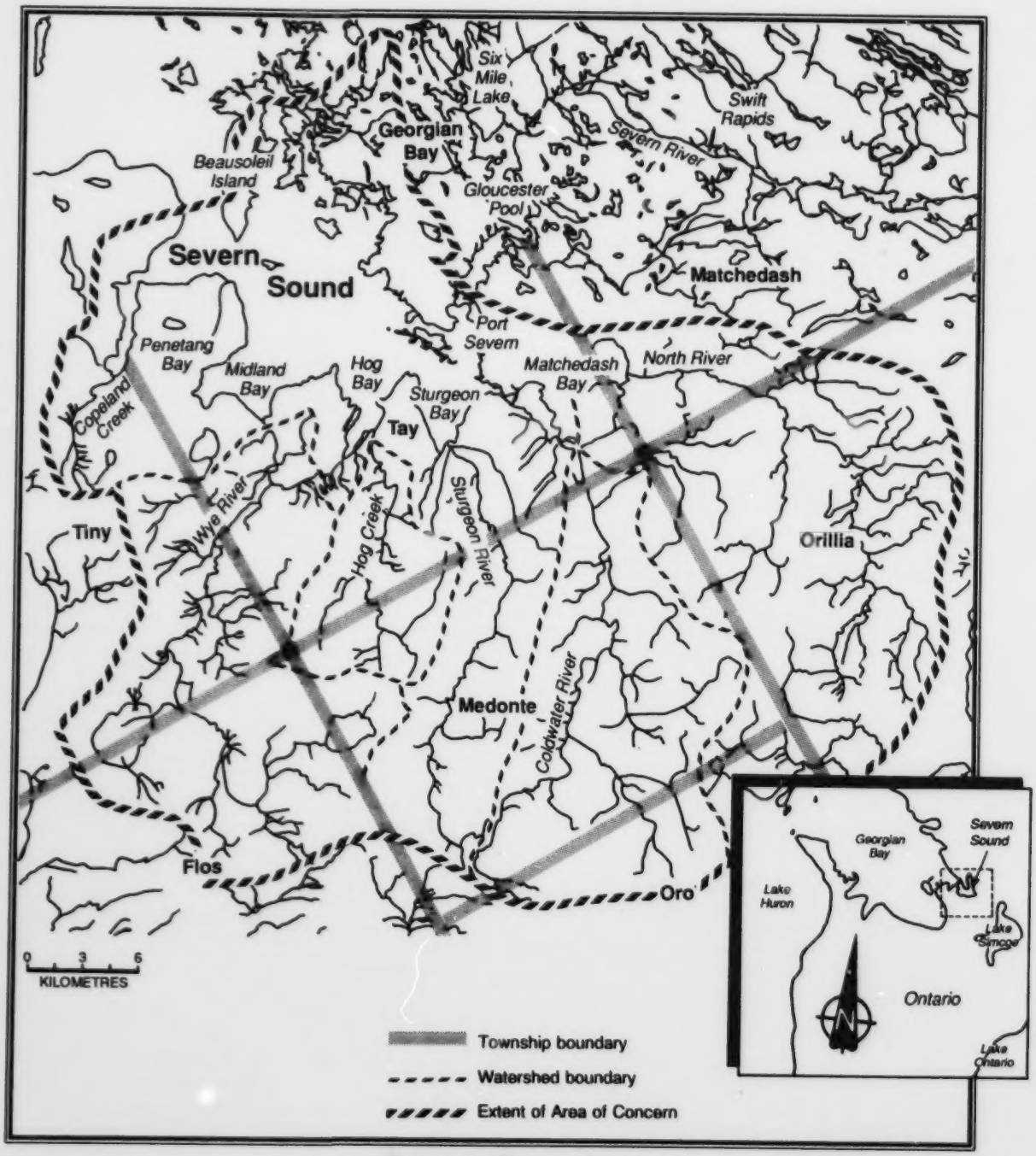
The Severn Sound Remedial Options Discussion Paper (RODP) was released to the public in June, 1990. A series of meetings with municipalities and other key implementors was held over the summer and fall of 1990 to further discuss the options and encourage response. Public meetings were held in October, 1990, to culminate the discussion period. The Public Response to the RODP is expected from the Severn Sound PAC by March, 1991.

The Stage II draft report will incorporate the public response to the Options Discussion Paper as part of the discussion of preferred options. In addition, updated environmental conditions and problem definition sections, economic analysis, a surveillance and monitoring plan and preliminary discussion of RAP implementation will be included.

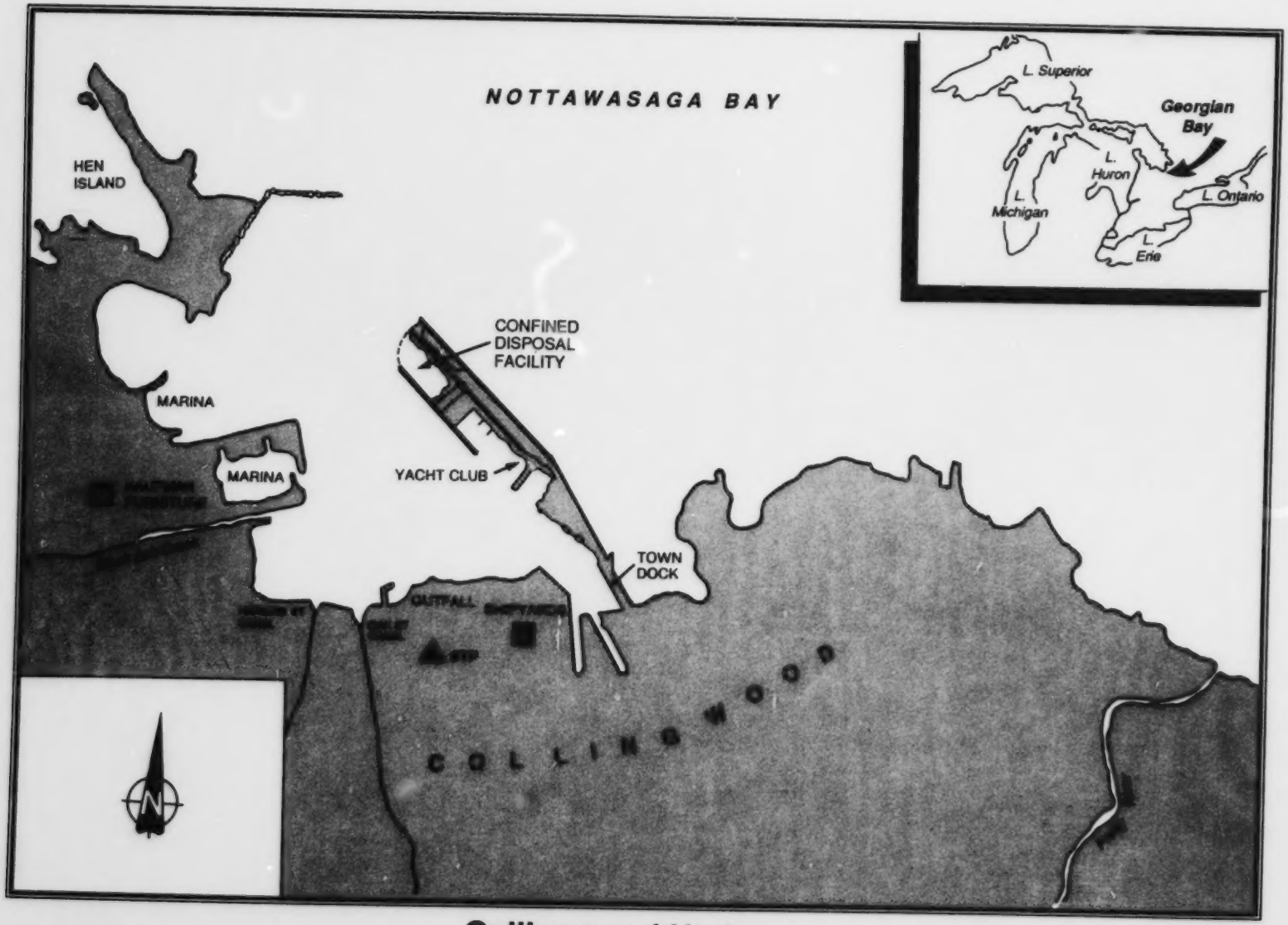
Collingwood Harbour

Collingwood Harbour was identified as an Area of Concern in 1977 due to nuisance algal growth, a result of excessive phosphorus loadings to the harbour. The principal cause of eutrophication was insufficient phosphorus removal from the effluent of the sewage treatment plant. Subsequent studies revealed the potential for trace metals and organic contaminants to be of an environmental concern due to the historic use of the harbour as an industrial base, particularly for the ship building activities of Canada Steamship Limited.

In numerous bioassays, surficial sediment did not adversely effect test organisms, and metal bioaccumulation was comparable to controls. Segmented core chemistry indicated that at some stations, surficial sediment is less contaminated than deeper sediment. Contaminants in sediment marginally exceed the provincial open water disposal guidelines at a limited number of stations but are not of toxicological significance. A technical report containing sediment bioassessment results was completed in April, 1990, and released in October, 1990.



Severn Sound Area of Concern



Collingwood Harbour Area of Concern

Nutrient concentrations in the harbour are substantially lower than in previous surveys, and mean phosphorus concentrations in the harbour waters from April to September, 1990, met the provincial objective of 20 µg/l for the prevention of nuisance algal growth. Further monitoring programs will be designed to continue to track nutrient dynamics particularly during storm events. During the summer months, bacterial counts met the provincial bacteriological objective for body contact recreation.

With a single exception of yellow perch greater than 14 inches (35 cm), there are no fish consumption advisories. The restriction on perch generated in 1984 was based on elevated mercury concentrations and was demonstrated not to be due to local sources in the harbour. Attempts were made to capture yellow perch of this size in 1990 through the MOE/MNR sport-fish program and by means of activities geared at the local public. Yellow perch measuring 35 cm were caught by local residents in the spring of 1990 and mercury concentration was 0.39 µg/g. The consumption advisory is based on tissue concentrations greater than 0.50 µg/g.

Sources of phosphorus to the Harbour include the sewage treatment plant (STP), watershed runoff and precipitation. The most significant single source of phosphorus is the STP. Bacteria can enter the harbour with watershed runoff and STP effluent. Loadings during storm events are being measured for comparison with the results of 1989. In 1989 approximately 73 per cent of the bacteria and over 90 per cent of the phosphorus entering the Harbour originated with the STP. The harbour waters meet the bacterial water quality objective for body contact recreation. Metal and PCB sources are from historic Harbour uses. The results of the water quality and hydrological surveys will be modelled to facilitate the development and evaluation of remedial options.

Public Involvement

The Public Involvement Program commenced in April, 1988, with a newsletter and an open house. This was followed by a second newsletter in September, 1988, and an information event referred to as Harbour Day. A PAC was formed in November, 1988, and a third newsletter, containing the desired use goals identified by the PAC was released in January, 1989. The first draft of the use goals was finalized in January following a public meeting. The RAP Team was present with an information display for exhibits during Environment Week and other festivals held in Collingwood in the spring and summer of 1989 and 1990, and at Collingwood Day at the Canadian National Exhibition (Toronto), September, 1989 and 1990. Development of remedial options commenced in September, 1989. A spring 1990 newsletter contained information on PAC, the RAP process, use goals and the development of remedial options. This was followed by Harbour Day 1990 in August which emphasized remedial actions and attracted well over 400 individuals.

The PAC chairperson and the RAP Co-ordinator give frequent presentations. Feature articles on the RAP have and continue to appear in the local press. A poster version of a tapestry map indicating sources of pollution to the harbour will be provided as a teaching aid to all classrooms in the Collingwood area, and will be available in the library, chamber of commerce, tourist office, and town hall. A regular column entitled R.A.P. Rap is authored by PAC members and appears in the local newspaper. Media coverage of the RAP process has been comprehensive.

A Draft Options Discussion Paper was reviewed by PAC in September, 1990, and submitted to the COA RAP Steering Committee in February, 1991. PAC has implemented a public awareness program containing crucial remedial actions for restoring water quality in the Harbour. This program began in March, 1990, with a radio phone-in talk show produced by the local radio station, with representation from the RAP Co-ordinator and the PAC Chairperson. Remedial options that focus on the STP are being reviewed by a PAC Technical Subcommittee in co-operation with the municipality. Concurrent with the PAC selection of preferred options in the spring of 1991, a newsletter will be produced informing the Collingwood community of the options under consideration by PAC, and inviting comments and attendance at a public meeting, an open house, and/or a workshop. The nutrient/bacteriological/hydrological model being produced for the RAP Team will be used to assist in the selection of preferred options. A socio-economic analysis was conducted by the town and a draft report made available to the RAP Team and PAC September, 1990. The town is recommending a comprehensive, computerized process audit to be conducted at the STP in conjunction with the needs of the town and the RAP.

In addition to the implementation of the public awareness program, remedial measures at the STP plant brought effluent quality within the provincial objectives. In 1990, the mean phosphorus concentration in STP effluent was 0.5 mg/L. Ongoing efforts include a plant process audit. A needs study is also under way under the Lifelines program to evaluate the extent of infiltration and storm/sanitary sewer connections.

Closure of the Collingwood Shipyards in 1986 brought a halt to contamination from the shipbuilding industry. Dredging of the harbour in 1986 removed sediment with metals and PCBs marginally above the provincial guideline for open water disposal of dredged sediment.

The *Stage I Report for the Collingwood Harbour RAP* was transmitted to the IJC in April, 1989. A supplement to the Stage I Report, containing representative results from the 1989 field investigations, was provided to the IJC in November, 1989. The preparation of the Stage II Report will commence with the release of the Options Discussion Paper.

Wheatley Harbour

Progress continues to be made on the Wheatley Harbour RAP with the submission of the Stage I Report. The document essentially synthesizes available environmental information, describes past and existing environmental conditions and trends, and determines the impacted beneficial uses and/or problems within the Area of Concern. A public meeting is currently being planned to present and discuss the report with all interested elected officials and local residents.

While the assessment of Environmental Conditions and Problem Definition has been completed, additional studies are still being carried out. Index fishing is being completed to determine the numbers and species of fish present in the harbour on a monthly basis. Not only does this study allow for the inspection of various species of fish for external tumours but allows for the determination of the most appropriate species for internal tumour studies if required. (This relates to the Remedial Action Plan as one of the fourteen IJC listing criteria.) Furthermore, the fish species found in the area on a year round basis can be used to determine impact from the harbour versus open lake impacts. PCB uptake levels by midge from Wheatley Harbour using emergent traps are being compared to midge from other locations removed from the Harbour. This again will enlighten the Team as to how tightly the PCBs are bound to the organics in the sediment. Routine monthly monitoring is continuing at the harbour and at all treated discharges. A small study was carried out in the summer of 1989 to determine sources of agricultural pollution including rural septic tanks and surface runoff.

Remediation in the Harbour has been proceeding as a result of Omstead's Foods upgrade of their waste water treatment plant to achieve new discharge criteria.

Public Involvement

The public involvement program is continuing with a variety of creative initiatives. Newsletters and/or briefings have been sent to members of the public on a seasonal basis since December, 1988. For the younger persons in the Wheatley Harbour Area, copies of the popular Dr. Seuss book *The Lorax* are being distributed to local schools and libraries. The book details the effects of a local pollution problem from a ecological perspective. A brief note about the Wheatley Harbour Area of Concern and how the story relates to the RAP has been included with each copy. The public involvement program will continue into the new year with several planning meetings and public meetings to review the Stage One Report. This process will continue with the winter 1991-92 release of the Stage II Report.

Hamilton Harbour

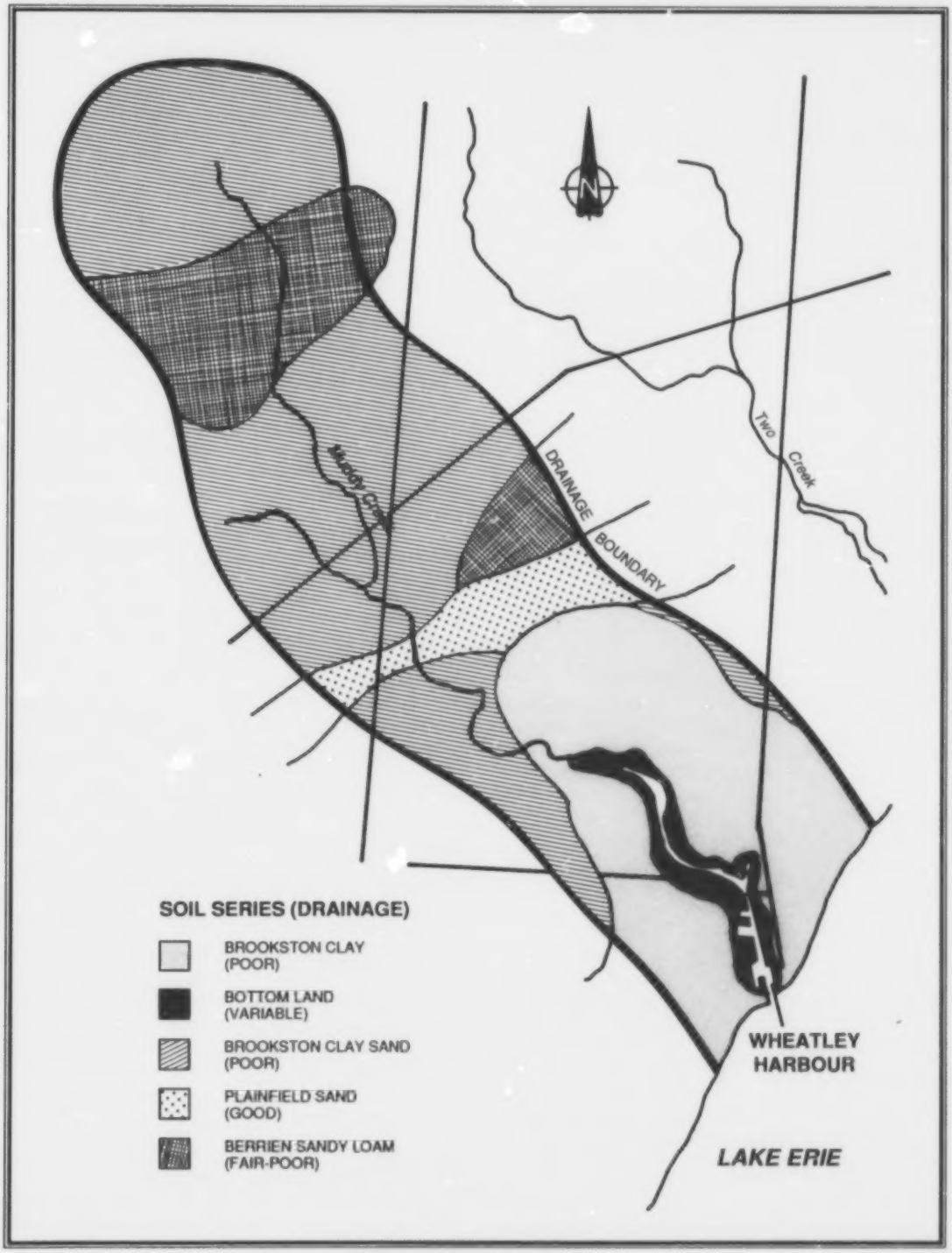
The Stage I report entitled "Environmental Conditions and Problem Definition" was completed in March, 1989, and submitted by the COA Review Board to the IJC in October, 1989. The report was accepted as having met the requirements for Stage I in June, 1990.

Based on the results of Stakeholder workshops, the RAP Team prepared a draft *Preferred Options Report* which was released in January, 1990. The report detailed the necessary steps required to improve or reinstate the water uses requested by the stakeholders, and the beneficial uses defined by the GLWQA. Stakeholders completed their review of the report by July, 1990.

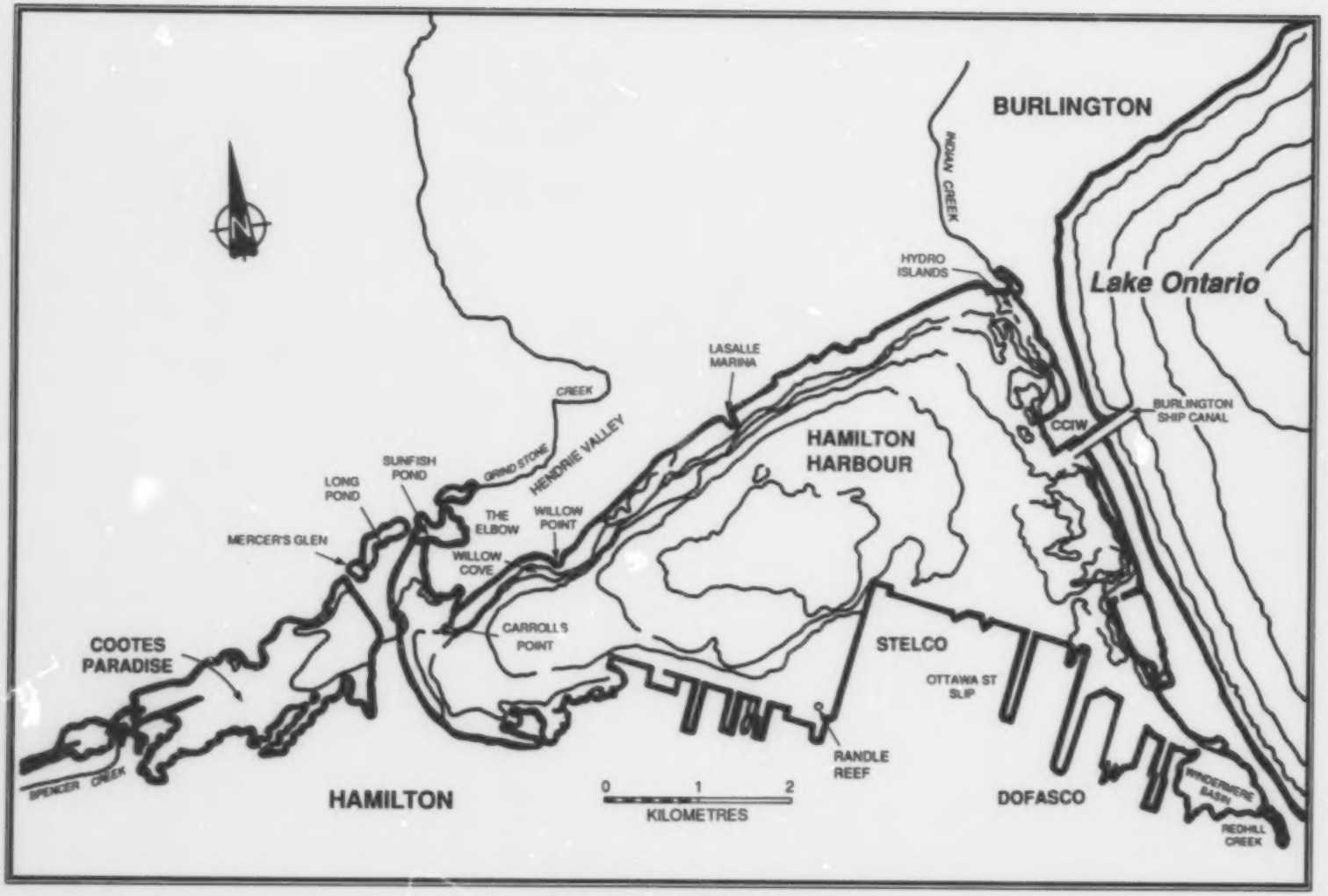
The draft report of the Stage II RAP is scheduled to be completed by early 1991. The final report including the list of commitments and schedules will be completed in late 1991.

Recent detailed assessments of sources and the biological effects of contaminated sediment have resulted in the discovery of a 'hotspot' comprised of 70,000 m3 of coal tar concentrated sediment. Polynuclear aromatic hydrocarbon (PAH) concentrations have been found to exceed 200 ug/g. The study has shown that, while the 'hotspot' is acutely toxic to aquatic organisms, low levels of toxicity occur throughout most of the remainder of the harbour. Therefore it is the coal tar area which urgently requires removal and treatment. A suitable procedure of *in situ* treatment for coal tar has not been found. Contaminant concentrations in sedimenting/resuspended solids, collected with sediment traps, varies regionally and depends on the depth and proximity to industrial areas. PAH concentrations sometimes exceed 5,000 ng/g, which is 2-3 times higher than in the bottom sediments. Metals in these traps routinely exceed the open water disposal levels specified in the Ontario sediment dredging guidelines. Four years of data are now available and will provide a background or benchmark with which to measure further improvements and the effects of dredging.

Intensive monitoring has shown that phosphorus and ammonia have changed little in response to improvements at the Hamilton STP; however, chlorophyll and water transparency seem to have shown some improvements. Concentrations of PCBs in tributaries, STP effluents, outfall areas, Hamilton Harbour water and



Wheatley Harbour
Area of Concern



Hamilton Harbour
Area of Concern

Lake Ontario intakes were 7-18 ng/L, 12-23 ng/L, 13-75 ng/L, 6-35 ng/L and 4 ng/L, respectively. The types of PCBs found indicate weathered material, rather than new sources. These ongoing PCB loads explain much of the concentration found in bottom sediments and sediment traps.

Analysis of water exchange between the harbour and Lake Ontario has confirmed the importance of the exchange in maintaining oxygen levels in the bottom water. It is thought that this exchange will produce acceptable oxygen levels if ammonia control is achieved.

In 1990, eggs of herring gulls, common terns, double-crested cormorants, and Canada geese were collected for organochlorine pesticide and PCB analysis from Hamilton Harbour. Chicks of herring gulls, common terns and double-crested cormorants were also collected at Hamilton Harbour. Soft tissues, blood and bone were analyzed for various biochemical indicators of stress and trace metal analysis. The results of this study are not yet available.

This information will be used to assess the health of the colonial waterbirds in the Harbour and nearshore Lake Ontario prior to any remedial actions occurring in the Harbour and to assess the health of the birds relative to a site in eastern Lake Ontario which was also sampled. Follow-up studies will be performed in future years to determine whether avian health has improved in reaction to contaminant declines in the ecosystem.

A number of remedial actions are under way within the Hamilton Harbour AOC. Hamilton-Wentworth Region, the Ontario Ministry of the Environment, and Environment Canada's Wastewater Technology Centre have been working together to develop an operating strategy to minimize the escape of effluent solids from the final clarifiers at the Dundas STP. Step-feed control strategies will also be initiated at the Woodward Avenue STP in 1990/91 and will be completed in 1991/92.

The Regional Municipality of Hamilton-Wentworth has installed a retention basin ($6.5 million) to reduce raw sewage discharges to Redhill Creek. Construction of a retention basin for the Chedoke Creek CSO is to begin in 1991.

A filtration optimization and process control project has been initiated at the Dundas STP.

The following projects have been initiated at the Skyway STP:

1. Enhanced computerized process audit
2. Assessment of the performance of existing secondary clarifiers
3. Hydraulic parameters assessment

All steps implemented at STPs since 1987 have reduced ammonia and phosphorus loadings by amounts (30% and 50%) that meet the reductions proposed for the first phase in treatment.

Containment of contaminated sediment in new CDFs in Windermere Basin commenced in 1989 and will be completed in 1991.

A Pollution Control Planning Study has been undertaken (Hamilton-Wentworth Region and Ontario Ministry of the Environment) to assess the options for controlling CSOs and related sewage collection problems, including modifications that may be required at the STPs to handle the increased flows. The final report is due in the spring of 1991.

Dofasco has recently completed the installation of a blast furnace water recycling system. Improved biological treatment of plant effluent will be completed in the near future. This undertaking is part of a $13 million program on process improvements over the past few years by Stelco and Dofasco designed to further reduce loadings of phenols, ammonia and suspended solids (with associated contaminants) to the Harbour. New sewer use by-laws in Hamilton- Wentworth have placed more stringent conditions on such discharges to the sewer system.

Several major new studies were initiated in 1990:

- A bacteria survey (June-August 1990) to identify whether the areas identified in the RAP as potential swimming sites in the Harbour meet bacteriological health requirements and, if not, to determine the source of the contamination.
- A biological assessment of sediment inputs to the Harbour to characterize the quality and quantity of suspended sediment from major sources and to estimate the potential, biological significance of current sediment sources.
- Regular and more intensive surveys of water quality chemistry and physical factors to detect changes due to nutrient abatement activities at STPs.
- Study of water circulation to help determine the degree of mixing between segments of the Harbour and to provide data for the hydrodynamic models required in future system models of water quality.

A number of sediment remediation demonstration projects have been initiated. A joint study amongst industry, Ontario Ministry of the Environment (MISA), and Environment Canada's Waste Water Technology Centre to address certain existing sediment treatment technologies and to identify the potential for new technologies started in 1990.

The study was undertaken to assess the possibility of potential methods of capping soft contaminated sediments *in-situ*.

Due to the presence of high concentrations of PAHs in bottom sediments, Hamilton Harbour is considered to be a suitable location to demonstrate the operational efficiency of a thermochemical waste reduction unit. Treatability studies for three other treatment techniques are also planned.

Hamilton Harbour may also be chosen as a site to demonstrate suitable technologies and equipment for the removal of contaminated sediment.

Public Involvement

In March, 1989, the Stage I report, *Environmental Conditions and Problem Definition*, was released and submitted to the Hamilton Harbour Stakeholder group. Workshops were held in June and July, 1989, to explore a series of technical and planning options. Based on the results of these workshops, a draft "Preferred Options Report" was prepared and released to Stakeholders in January, 1990. The report detailed the necessary steps required to improve or reinstate the water uses requested by the Stakeholders. Stakeholders met monthly to discuss and reach consensus on detailed recommendations for remedial actions. This review was completed by the end of July, 1990. As a result of this review, all recommended actions in the draft RAP are based on consensus among local Stakeholders, including agencies.

In February, 1990, the stakeholders appointed a five member Interim Executive Committee and began to work towards establishing an organizational framework under which to operate during RAP implementation.

At the Stakeholders' request, a "visions" workshop was held in September, 1990, to provide the group with an opportunity to explore all possibilities related to the RAP from a broad ecosystemic perspective.

Stakeholders finalized a RAP implementation model in 1990 which called for the formation of an incorporated organization with a mandate supportive of RAP implementation.

Metro Toronto and Region

A number of significant developments have occurred within the Metro RAP area in the past two years.

The Royal Commission on the Future of the Toronto Waterfront has further assisted in the promotion of the Toronto RAP. The Environment and Health hearings were held in August, 1989, and May, 1990, and incorporated into the *Interim Report - Summer 1989* and *Watershed Interim Report - August, 1990* respectively. Representatives from the RAP Team presented deputations at each set of hearings. The Royal Commission was supportive towards the Metro RAP and expressed a strong desire for a comprehensive ecosystem management, which is the major thrust of the Metro RAP program. Recommendations from the Royal Commission described in the *Interim Report - Summer 1989* suggested the need for more public involvement. The *Watershed Interim Report - August, 1990* recommended that each municipality should be a joint partner in developing and implementing the RAP rather than as a separate stakeholder. Both these concerns are being taken into consideration by the RAP committees.

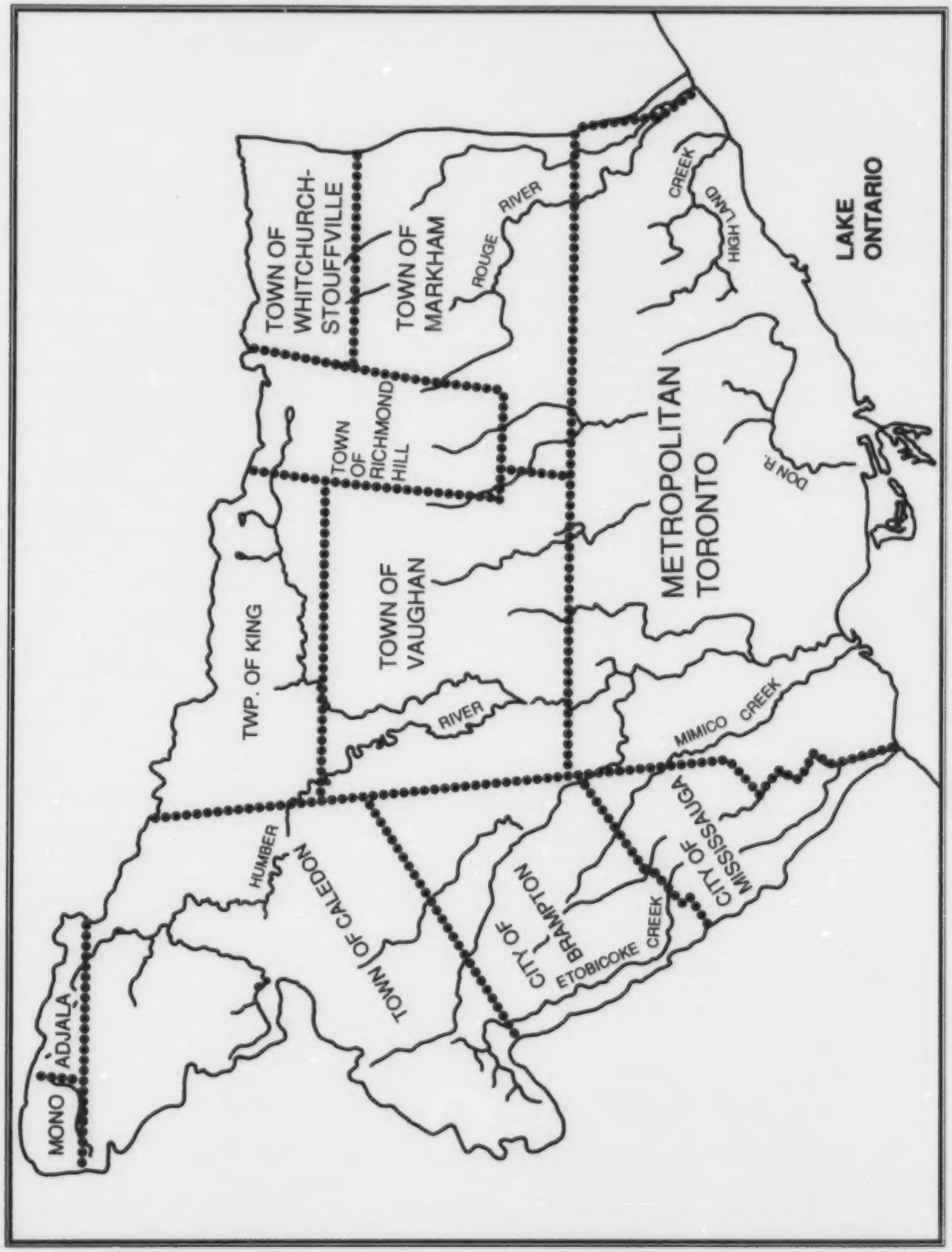
Further developments in the Metro Toronto RAP include the publication of several reports. The *Stage I: Environmental Conditions and Problem Definition* report was submitted to the RAP Steering Committee in December, 1988, and to the International Joint Commission in March, 1990, for review and comment.

The information collected on existing programs and the estimated costs for different levels of enhancement was used to formulate the *Draft Discussion Paper on Remedial Options* which was released in April, 1990. The Executive Summary of the document was sent to over 1200 individuals, groups, and municipal staff representatives from seventeen municipalities, and provincial and federal agencies involved in the Metro RAP. The *Draft Discussion Paper* focuses on seven remedial intents which, if implemented in an integrated fashion, strive for an ecosystem approach to cleaning up the Toronto watershed.

The seven remedial intents are:

- Implement Specific Plans to Correct Localized Use Impairments
- Reduce the Impacts of Treated and Untreated Sanitary Sewage
- Reduce the Impacts of Dry Weather Sources
- Reduce the Impacts of Stormwater Runoff
- Increase Public Awareness and Public Involvement in Environmental Programs
- Foster Ecosystem Thinking Both Within and Outside the Metro Toronto RAP
- Conduct Research in Support of Short and Long Term RAP Implementation

Currently, the Options Paper is being reviewed by the PAC and the Technical Advisory Committee (TAC) and a preferred options paper will be incorporated into a strategy paper in mid 1991.



Metro Toronto and Region Area of Concern

A number of remedial actions have been undertaken while development of the RAP has been in progress. Construction of the Eastern Beaches Detention Tank to detain combined sewer overflow and storm runoff with subsequent treatment at Metro's Main Sewage Treatment Plant was completed in the spring of 1990. The elimination of direct discharges from the sewer system into the nearshore area will provide physical, chemical and bacteriological improvement of beach water quality. By eliminating the direct load to bottom sediments, resuspension should be reduced in the long run as well.

The Waterfront Water Quality Improvement Program began in 1984 and has assisted Metro Toronto and area municipalities with studies and remedial works to improve the quality of area water courses and the waterfront. At present, the Ontario Ministry of the Environment and the City of Scarborough are conducting the Dunker's Flow Balancing System feasibility Study. The Dunker's Flow Balancing System consists of a series of cells created by vinyl curtains and supported by pontoons. The cells store sewer effluent discharge during periods of high flow until it can be returned to a treatment facility once flows diminish and capacity is available at the plant. This study is investigating the feasibility of using this device for storage of CSO effluent from one of six waterfront outfalls.

The RAP Team has recognized a deficiency in data for various contaminant inputs to the waterfront including storm sewers and combined sewer overflows. During wet weather conditions these discharges can be significant sources of pollutants to the waterfront. At present, the Ontario Ministry of the Environment is conducting a study to assess dry and wet weather loadings from storm sewers and combined sewer overflows along the Metropolitan Toronto Waterfront. A stormwater flow and water quality prediction model is also being developed. The results of this study will provide baseline data for the development and assessment of remedial measures, establish the peak periods of contamination to the waterfront and provide loading estimates for receiving water modelling applications.

Public Involvement

The Public Advisory Committee (PAC) developed a set of RAP Goals which were distributed to all involved municipalities in September 1989 for comment or endorsement. All of the area municipalities were asked to review and endorse the Goals. Workshops and other informative discussions were conducted with the PAC. Program activities continue to familiarize the public about the RAP process and encourage community involvement. Newsletters, displays and the distribution of discussion papers promoted public awareness.

Port Hope Harbour

Approximately 90,000 m^3 of sediment in the turning basin and west slip area of Port Hope Harbour are contaminated with uranium and thorium series radionuclides, heavy metals, and PCBs. Contamination is believed to be primarily the result of waste management practices associated with radium and uranium refining operations in Port Hope prior to 1948.

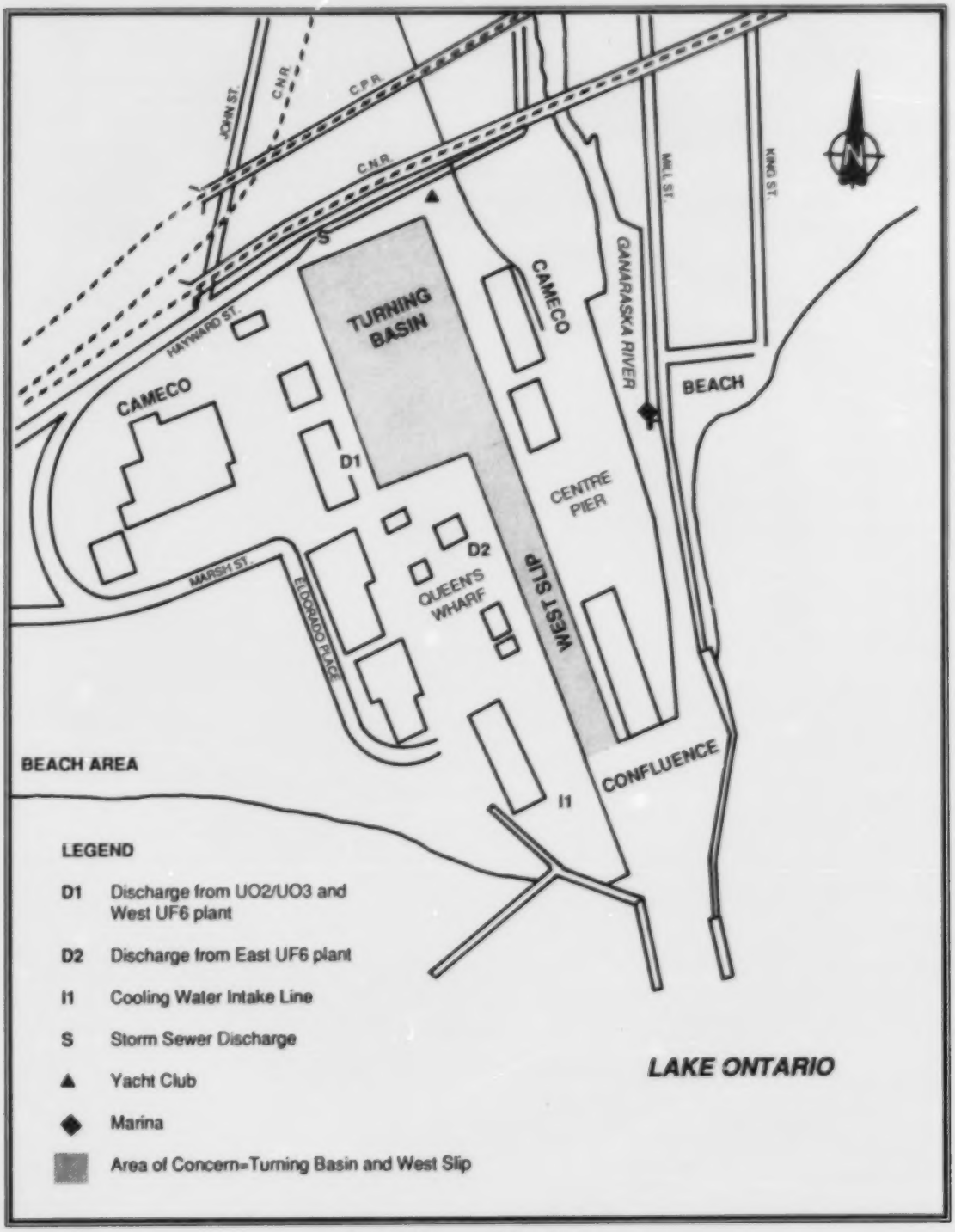
The radionuclide content in the sediments of the turning basin and west slip require that storage and disposal of any removed sediments be in a low-level radioactive waste management facility licensed by the Atomic Energy Control Board. No such facility is currently available, therefore the sediments cannot be removed at this time. Other remedial options could be considered if the harbour uses change in the future. If a new harbour was built and the turning basin was no longer used as a small craft harbour then *in-situ* remedial measures could be considered.

Port Hope Harbour is an example of a small area of concern in terms of spatial content (less than 40,000 square miles), local population (approximately 10,000 people), stakeholders (one industry and one user group) and demonstrated impact (recreational boating is marginally impaired due to restrictions on dredging of contaminated sediments).

It is very important to recognize the fact that the radionuclide contamination of the harbour sediments is part of a larger radiological contamination problem in the Town of Port Hope. Long term management plans are being developed and implemented to deal with both contaminated harbour sediments and concentrated land based sites.

In the case of Port Hope, RAP development and implementation is a continuing factor but not the sole means of achieving the goal of cleaning up the Area of Concern. The RAP Team is working together with various other groups to jointly help solve the problem.

The Low Level Radioactive Waste Management Office (LLRWMO) was created by the federal government to discharge its responsibilities for low level radioactive waste management. This includes the responsibility for the historic low level radioactive wastes in Port Hope. The LLRWMO is currently dealing with the interim storage of radioactive materials contained on land-based sites. The function of the LLRWMO in the decision-making process is to provide technical and economic assessments and recommendations to the federal government regarding the management of historic low level radioactive wastes in Port Hope. The LLRWMO will then be responsible for implementing policy decisions made by the federal government.



Port Hope Harbour
Area of Concern

A Siting Task Force established by the Minister of the Federal Department of Energy, Mines and Resources is responsible for finding a site in Ontario to locate a low level radioactive waste management facility. The radioactive wastes from Port Hope are intended to be disposed of at this facility. This Task Force is implementing a five phase siting process that encourages the voluntary/collaborative participation of communities in the search for a low level radioactive waste facility site.

The Siting Task Force has also formed a Community Liaison Group (CLG). The function of this group is to inform the citizens of Port Hope about the radioactive waste problems and the remedial options being considered, as well as provide the Siting Task Force with feedback outlining community concerns, ideas and viewpoints.

Public Involvement

The RAP Team created a group called the Port Hope Local Advisory Team (LAG). The LAG primarily consists of stakeholders of the harbour and concerned citizens, but also has representatives from local governments and organizations, the Siting Task Force and the LLRWMO.

Another group involved in the remediation process is the Port Hope Environmental Advisory Committee (EAC). The EAC is a committee that reports to the Town Council regarding environmental issues in Port Hope.

The remediation of Port Hope Harbour is a very public oriented program. The citizens of Port Hope are well informed and have many opportunities to voice their opinions and take part in the decision-making process.

The remediation of Port Hope Harbour is a joint effort to clean up the harbour by several groups that have the common goal of developing an environmentally sound plan which reflects the views of the community.

Bay of Quinte

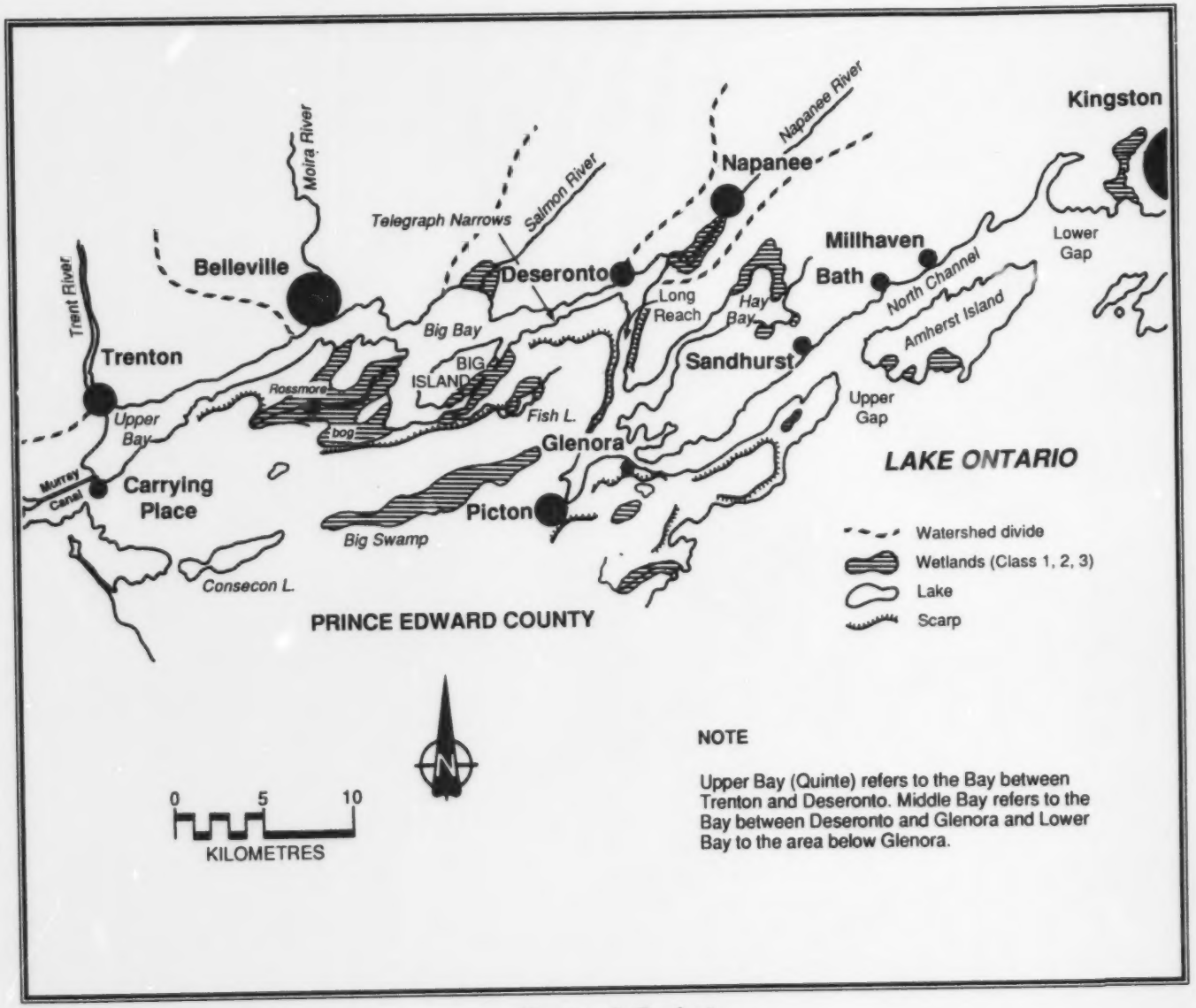
In 1985, the Bay of Quinte was designated a Great Lakes' Area of Concern by the International Joint Commission. Nine of the fourteen Beneficial Uses outlined in Annex 2 of the 1987 Great Lakes Water Quality Agreement were impaired. In general terms, the water quality problems include: (1) excessive nutrient inputs resulting in nuisance algal production; (2) localized areas of bacterial contamination near Belleville, Trenton, Deseronto and Picton which requires closing beaches and reducing body-contact water recreational opportunities; (3) loss of fish and wildlife habitat related to water quality, the disappearance of rooted plants and unplanned shoreline development; and (4) heavy metal and organic contaminants in sediments and the presence of mercury, PCBs and mirex in some size classes of some fish species meaning sediments cannot be dredged in the former case and fish consumption advisories exist in the later. Acceptable levels of contaminants exist in most fish species and size classes; however, the larger sizes of some important species, including walleye and eel, are affected. Dioxins at low levels also have been detected in some size classes of some fish species.

There are no direct industrial waste discharges to the Bay of Quinte. Domtar Wood Preserving, Domtar Packaging and Trent Valley Paperboard Industries discharge effluent to the Trent River; Strathcona Papers discharges effluent to the Napanee River; and surface and ground drainage of contaminants occurs at Bakelite Thermosets at Belleville.

In 1988, a toxic contaminants survey of all point source and tributary inputs was completed. Both metal and persistent contaminants were surveyed. Regarding metals, Domtar Packaging, relative to the other Bay of Quinte industrial dischargers, is a major source of aluminum, chromium, copper, iron, mercury, manganese and zinc. The most frequently detected toxic organic compound in industrial effluent discharges is pentachlorophenol (PCP). Concentrations in 1988 ranged from 27 to 2200 $\mu g/L$ at Domtar Wood Preserving and from 0.61 to 35 $\mu g/L$ at Trent Valley Paperboards. PAHs also were found in the effluent at Domtar Wood Preserving in 1988 (Poulton, 1990).

Treated municipal, industrial and institutional wastes are discharged to the bay at Trenton, Belleville, Deseronto, Napanee, Picton, Prince Edward Heights STPs and the Canadian Forces Base at Trenton. With the exception of Canadian Forces Base Trenton and Prince Edward Heights (accurate data unavailable) and the Napanee plant, all Quinte sewage treatment plants (STPs) are in compliance with the 1 mg/L discharge limit for phosphorus. As well, a more stringent Bay of Quinte Control level of 0.5 mg/L (monthly mean) between May and October was attained in 1989 at four STPs (Belleville, Trenton, Deseronto and Picton). In terms of heavy metals, high concentrations of copper, iron and zinc were found in the Trenton STP effluent in 1988 relative to the other Bay of Quinte STPs (Poulton, 1990).

Bacteriological contamination occurs in close proximity to tributary mouths or municipal discharges. The problems differ in each area and differences may be related to combined sewer overflows (CSOs), illegal cross connections of storm and sewage pipes, STP or sewer collection system bypass, inflow and infiltration (I/I) concerns and/or illegal connections (e.g., roof drains).



Bay of Quinte
Area of Concern

There are 7,000 hectares (ha) of remnant wetlands left within the Bay, while 12,000 ha have been destroyed. Five wetlands with a combined area of about 4,400 ha are Class 1 or 2 and, as such, will be protected by the proposed Ontario wetland policy.

Further restoration of water quality in the Bay of Quinte ecosystem is possible. Additional pollution abatement actions are required. These measures could include further point source controls, reductions in tributary, agricultural and diffuse urban loadings, inactivation or removal of contaminated sediments, and improved fisheries habitat and wetland protection.

The Bay of Quinte RAP is being developed by a federal/provincial Co-ordinating Committee with recommendations from the Bay of Quinte RAP Public Advisory Committee. The Co-ordinating Committee has representatives from the Ontario Ministries of the Environment, Natural Resources, and Agriculture and Food, as well as the Federal Department of Fisheries and Oceans and Environment Canada. The PAC has representation from the following sectors: municipal, industrial, human health, sport and commercial fisheries, native peoples, environmental groups, education and farming.

The two committees have pursued three actions: (1) technical review of the water quality problems; (2) model development to compare and assess potential remedial actions; and (3) public education and consultation. These actions have resulted in completion of the Stage I Report, ensured public ownership of the Bay of Quinte RAP, and allowed for a thorough evaluation of remedial options to combat phosphorus loadings.

A *1987 Progress Report* and 12 technical-background reports have been completed. Six additional studies are under way. The *Stage I Report: Environmental Setting plus Problem Definition* has been reviewed and approved by the (COA) RAP Steering Committee and transmitted to the International Joint Commission.

Predictive models are being used as building blocks for the Bay of Quinte RAP process. The models integrate scientific information while allowing for management evaluation and effective public consultation. The models' predictions were instrumental in the release of the 1989 *Time to Decide: A Discussion Paper* report and the provision for a comprehensive public evaluation of remedial options.

Three models have been built: (1) a "Phosphorus - Ecosystem" model; (2) a "Fate of Toxic Contaminants" model; and (3) a Geographic Information System (GIS) relating aspects of water quality, rooted aquatic plants and fish habitat to shoreline uses. A fourth model - "Biotic Interactions" - is in preparation.

The "Phosphorus - Ecosystem" model allows the joint Bay of Quinte RAP committees to determine, measure and compare factors (natural and man-made) affecting algae production and different remedial actions to reduce nutrient (phosphorus) loading. Sources of phosphorus were identified and the remedial options were compared.

The "Fate of Toxic Contaminants" model is a mass balance model based on the theory of fugacity. In this case, the transition (state or combination) of a chemical in an aquatic setting and the factors affecting the chemical's transition are measured as that chemical moves between geographic sites and/or within the water column. The output is chemical concentrations. In 1989, arsenic, pentachlorophenol (PCP) and polychlorinated biphenyl (PCB) were modelled. In 1990, thirteen other contaminants will be assessed.

The GIS maps areas of aquatic plants and pike habitat, and predicts changes to these features if remedial actions are taken.

The sources of bacteriological contamination at Belleville - including storm sewer and storm event bypassing at the STP - have been studied and the Belleville STP has been audited. Some remedial work is under way in the collection system, but as of 1990, bypassing continued to occur and recommendations from the audit had not been implemented. As well, the source of bacteriological contamination were examined at Picton and, as a result, plans to decommission the Prince Edward Heights STP in 1990-91 are being considered and some rehabilitation of the Picton sewer collection system is under way. The Canadian Forces Base Trenton STP also was audited; rehabilitation of the collection system is planned and refurbishing of the STP is under discussion. A suspected source of bacterial contamination at Domtar Packaging was investigated. No remedial actions were required; the plant processes were not contributing to the problem. To lessen diffuse urban bacterial inputs, urban storm water management is being applied to future urban expansion.

Part 1 of the Stage II Report will be completed in 1991. Part 1 will contain the recommended remedial actions and an implementor commitment in principle to the Bay of Quinte Remedial Action Plan. Formal commitments and an implementation schedule will be the key elements of Part 2.

Discussions to implement the Bay of Quinte RAP (completing Stage II - Part 2) were initiated in 1990. Options for an implementation structure were tabled and terms for a PAC Implementation Committee negotiated.

Public Involvement

The local PAC and the RAP Coordinating Committee undertook an extensive three-year (1987-1989) public education and consultation program which culminated with the completion of the Bay of Quinte RAP *Time to Decide: A Discussion Paper* 1989 report, the 1989 *Time to Decide* video and the *1990 PAC Report*.

The Bay of Quinte PAC has 21 members, the public-stakeholder mailing list numbers over 1000 persons, 200 presentations have been made to interest and education groups, and 14 formal public meetings or open houses held. Public input to the *Time to Decide: A Discussion Paper* report was received from a wide range of organizations and many public recommendations for action were endorsed by the larger stakeholder group. This input was collated in the *1990 PAC Report* and formally presented to the Co-ordinating Committee and COA RAP Steering Committee in April, 1990.

In 1990, the COA RAP Steering Committee and Bay of Quinte PAC initiated discussions regarding continued public involvement, sharing of responsibilities and a creation of a permanent joint agency/public implementation steering committee.

Regarding nutrient enrichment, three restoration objectives have been adopted by the Bay of Quinte PAC: (1) a reduction in the average concentration of total phosphorus in the Upper Bay; (2) a reduction in the average algal density; and (3) an increase in the potential area of rooted aquatic plant coverage. In addition to the stated objectives, the PAC proposed other cleanup recommendations *(see 1990 PAC Report)*.

Binational Remedial Action Plans

St. Marys River

The St. Marys River Remedial Action Plan has made significant progress in working towards the completion of the Stage I RAP Report. The present schedule indicates that the Stage I document will be available for agency review in early 1991. The Binational Public Advisory Council (BPAC) is expected to complete its review of all chapters, with the exception of the Executive Summary, by February 28, 1991. Concurrent with the BPAC review of the Stage I Report, the document will undergo a technical review.

In addition to the BPAC providing comments on the Stage I Report, three goal setting workshops have been held by the group. Goals were finalized in December, 1990. The BPAC views the workshops and goal setting exercise as a positive step towards Stage II and looks forward to working with the RAP Team to establish one set of RAP goals for the St. Marys River.

The St. Marys BPAC has met on a monthly basis in an effort to ensure the timely progression of the St. Marys River Remedial Action Plan Stage I document. The RAP Team has identified use impairments and documented the problems in the draft Stage I RAP Report.

The following ongoing projects have been undertaken in response to Upper Great Lakes Connecting Channels Study and/or RAP concerns:

- Beak Consultants Limited has been contracted to conduct a comprehensive investigation of the Algoma Slag Site. The purpose of the study is to quantify loading rates of constituents of concern and identify their potential pathways into groundwater and into the St. Marys River. The draft report was submitted in December, 1990.
- A sediment/benthic investigation of the Algoma Slip to document existing environmental conditions has been undertaken.
- Two water quality/effluent monitoring/current metering surveys were completed at the Sault Ste. Marie Wastewater Treatment Plant (WWTP) in 1989. As a result of the detection of high fecal coliform densities associated with floating material downstream of the WWTP, sediment samples were taken and submitted for bacterial and chemical contaminants analysis. Data analysis is in progress.

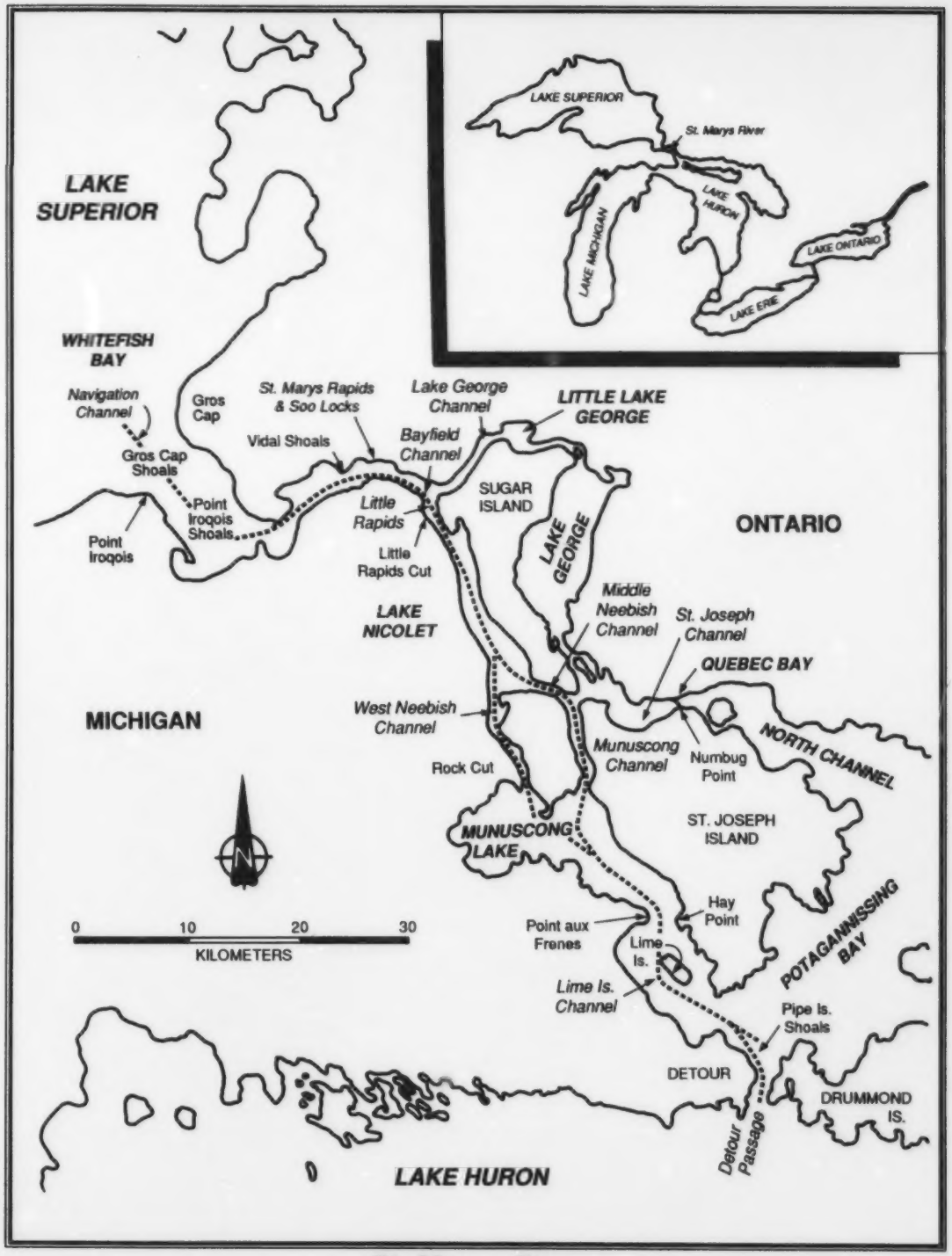
The results of these studies will be used to update the existing environmental conditions of the river, as will MISA data when it becomes available.

Abatement activities have also progressed in parallel with the RAP document. Algoma Steel Corporation completed construction of a new wastewater treatment plant in March of 1990. The new plant is expected to significantly reduce the discharge of suspended solids, oil and grease to the river.

Both the RAP Team and the BPAC are looking forward to the completion of Stage I and the commencement of work on the Stage II report.

St. Clair River

The Remedial Action Plan for the St. Clair River has benefited greatly from active participation by members of Binational Public Advisory Council (BPAC) as well as a knowledgeable and diverse membership on the RAP Team. The RAP Team, while being comprised primarily of technical experts from the various participating agencies, also includes two members and two alternates representing the BPAC. This organizational structure has allowed BPAC a greater understanding of the complexity and magnitude of the St. Clair River RAP. It has



St. Marys River
Area of Concern

St. Clair River
Area of Concern

also provided a more effective means of two-way communication between BPAC and the RAP Team.

The BPAC has established several subcommittees to consider issues pertaining to membership, bylaws, guiding principles and emergency spills notification protocols.

Numerous invited speakers have made presentations to BPAC on such diverse topics as: the Great Lakes Water Quality Agreement, River Separation Initiatives, Wetland Habitat and Landfills. Further, a sediment workshop was facilitated by the RAP Team in July, 1990, to provide insight into current regulatory and research initiatives with respect to contaminated sediments.

Several environmental investigations have been initiated in 1989-90, including:

- In support of the St. Clair River RAP, a detailed investigation of Talfourd Creek was initiated in 1989 to assess both current and historical contamination and sources in the Creek and the extent of impact on the St. Clair River.
- Sediment quality and benthic invertebrate sampling was completed in 1990 at 64 stations in the St. Clair River, with additional emphasis on the upper portion of the river along the Ontario shoreline. Biomonitoring with caged mussels for organic and inorganic contaminants was conducted in 1990 at ten selected stations in the upper river. Water quality sampling (conventional parameters only) was also performed at these stations and the first stage of sediment toxicity and bioaccumulation testing (bioassays) using fathead minnows, chironomids and mayfly larvae was completed. Data analysis is in progress for all projects.

Detroit River

The Detroit River Remedial Action Plan has achieved a significant milestone in the distribution of the Stage I RAP for agency review in November, 1990. The Binational Public Advisory Council (BPAC) has had an opportunity to review each chapter and the RAP Team has made a concerted effort to respond to BPAC comments in a responsible manner.

In addition to providing input in the development of the Stage I document, the BPAC has established several subcommittees and invited speakers to provide expert advice aiding in BPAC issue resolution.

Following review by agencies, the Stage I document will undergo public review prior to submission to the IJC.

Resource Centres have been established to facilitate public access to RAP documentation, including the Stage I document and its complete Appendices, and other RAP related information. These centres are situated in local public libraries, as well as the University of Windsor library, and the Ontario Ministry of the Environment District Office.

The Detroit River BPAC has met at intervals of approximately four to six weeks since December of 1988. A number of initiatives have been undertaken as part of the public involvement program, including development of a display for mall exhibits and for use by local interest groups. This display is currently on tour in various locations in and around Windsor.

In addition, a BPAC sponsored cruise of the Detroit River occurred in June, 1990. Approximately 220 people attended and expressed great interest in sights that were observed as well as the technical information conveyed to them.

A slide show and associated text, as well as speaking material is currently under preparation for use by RAP/BPAC volunteers at local engagements.

Environmental investigations recently initiated include the following:

- The Upper Great Lakes Connecting Channel Study report (UGLCCS, December, 1988) identified Ford Canada, West Windsor WPCP and General Chemical (Allied Chemical), Amherstburg as Ontario's major point source dischargers to the Detroit River. An UGLCSS recommendation suggested further examination of the specific impacts of these sources on the Detroit River ecosystem, in particular the benthic region. This study, initiated in 1990, should provide the required information for establishing a cause/effect relationship between a specific point source discharge and an impacted zone.
- A bacterial investigation was conducted in 1988 to determine if any improvements had occurred since 1987 studies, as a result of upgraded treatment at municipal water pollution control plants. Results from the 1987 surveys indicated that Ontario nearshore conditions have not changed significantly since 1984 but have degraded somewhat since 1975.
- Coincident with the 1988 bacteriological survey was a study to determine the occurrence of organic contaminants (including PAHs) in Ontario nearshore waters of the Detroit River. This satisfied two needs, including a lack of recent data on the levels of waterborne organic contaminants as well as addressing more recent concerns of PAH

Detroit River
Area of Concern

loadings from Ontario point sources highlighted in the UGLCCS point source report.

Niagara River

The Stage I document detailing environmental conditions, sources, as well as public concerns on impaired uses of the river, has been prepared and submitted for review by PAC members and the COA RAP Steering Committee. The report highlights the environmental problems associated with conventional and persistent toxic contaminants. Ongoing long-term monitoring programs provide key information on current water quality conditions, under the Niagara River Toxics Management Plan, and for contaminant levels in biota (sport fish, young-of-the-year spottail shiners, mussels, leeches and Cladophora).

Reference is made to the magnitude of contamination sources on the U.S. side of the river, particularly with respect to persistent toxic contaminants such as PCBs, mirex, dioxins and other chlorinated hydrocarbons. Canadian industrial and municipal point sources on the Welland River and the tributaries of the Niagara River system contribute to local impairments, including contaminated sediments, beach closings, and the degradation of benthos, fish and wildlife communities. The combined effects of U.S. and Canadian historical and ongoing sources of both organic and inorganic contaminants also contribute to fish consumption restrictions and tumour incidence. High loadings of suspended solids impair critical fish habitat and spawning areas.

A commitment has been made to fund a technical options study through tender jointly by the Ontario Ministry of the Environment and Environment Canada. The results of the assessment will form the basis of discussions among the RAP Team and PAC in determination of preferred options as part of the stage II document. The Stage II submission deadline has been extended into the 1992/93 fiscal year due to funding delays and changing representation on the RAP Team. Approval has been given under the Great Lakes Action Plan to tender the technical options project and tenders are anticipated by late 1990.

The Ontario Ministries of Environment and Natural Resources, along with Environment Canada, have undertaken a number of studies as a result of the commitment to develop a RAP for the Niagara River and to fulfill the requirements of the Niagara River Toxics Management Plan (NRTMP). These include:

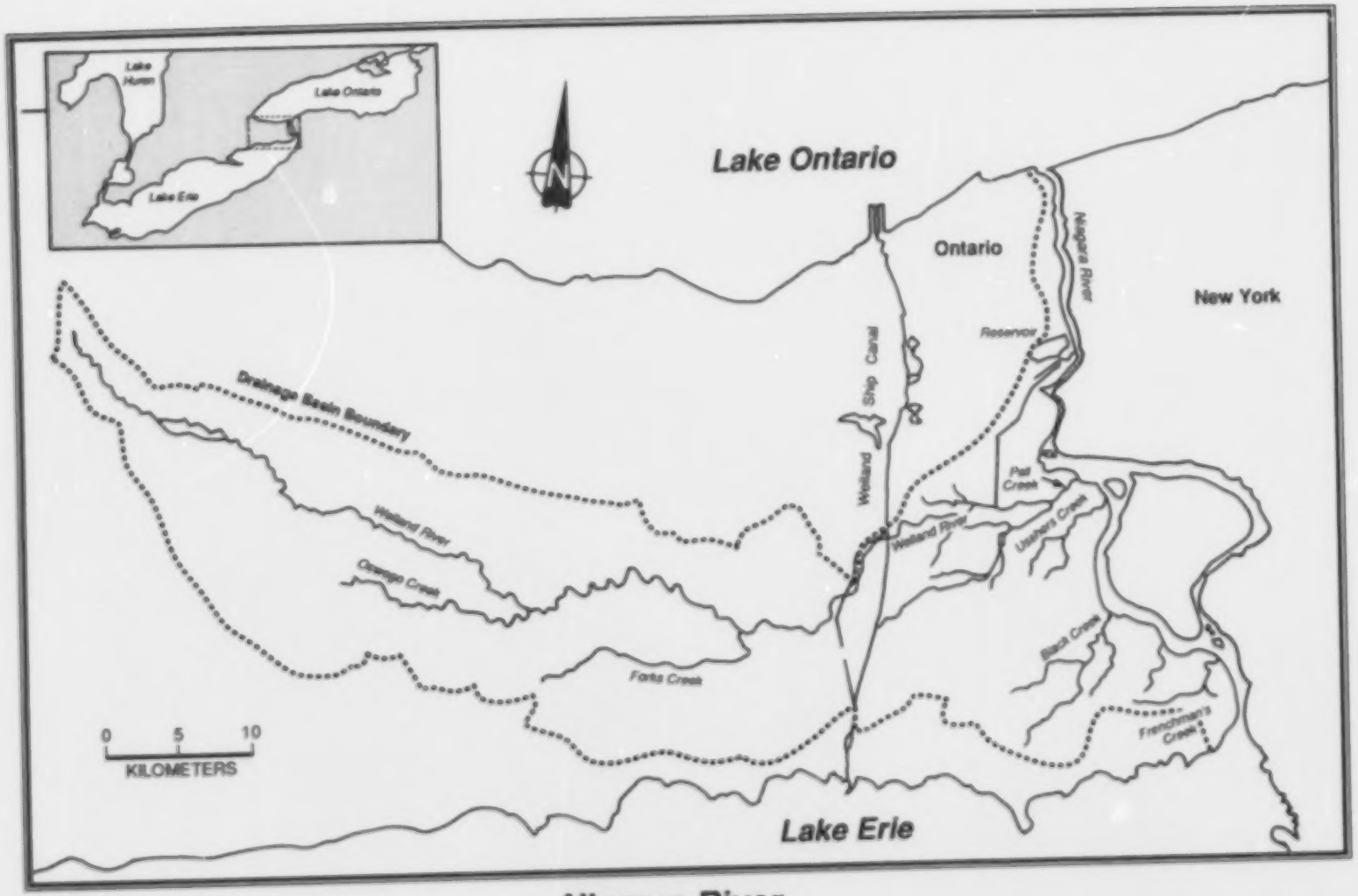
1. Annual monitoring of a wide range of conventional and toxic contaminants from all point source discharges.
2. Continuing investigations at all landfills identified in the NRTC report and estimation of the loading of contaminants to the Niagara River from these sources.
3. Annual biomonitoring of contaminants using freshwater clams, leeches, Cladophora and spottail shiners.
4. Year-round monitoring of ambient whole water river chemical concentrations at Fort Erie and Niagara-on-the-Lake.
5. Monitoring of chemical concentrations in raw and treated drinking water at filtration plants in the Niagara Peninsula.
6. Sampling and analysis of sport and forage fish flesh in the upper and lower Niagara River for toxic contaminant body burden and establishment of consumption advisories where required.
7. Determination of loading of contaminants to the Niagara River from Ontario-based tributaries through the implementation of a detailed 12 month intensive investigation and analysis program.
8. Production of an aerial video record of the Welland River floodplain in preparation for an aquatic habitat assessment of the river system.

In addition to the projects listed above that are under way, the Ontario Ministry of the Environment is also planning the following study specifically as a RAP related activity:

9. A survey to assess the environmental condition of the lower Welland River between Welland Airport and Chippewa, with particular emphasis on sediment quality. This project has been awarded through the tendering process and the first round of samples have been collected and are currently being analysed.

Public Involvement

A Public Advisory Committee was established in January, 1989, and meets monthly at the City Hall in Niagara Falls, Ontario. Current PAC membership is 35 individuals representing 14 sectors in the Niagara area. Dr. Ian Brindle of Brock University was elected PAC Chairman and terms of reference for the PAC have been approved by the membership along with rules of order. The PAC have recently agreed to statements of impairments and are currently refining statements of desired uses and goals for the Niagara River.



Niagara River
Area of Concern

In addition to their regularly scheduled monthly meetings, five members of the PAC, including the Chair, have been meeting on a regular basis with their counterparts on New York's public advisors, the Niagara River Action Committee for the Niagara River (New York) RAP. This joint Canadian-U.S. group, referred to as the International Advisory Committee (IAC), has met monthly since March, 1990.

Public meetings were held in November, 1988, to present the Remedial Action Plan concept to the Niagara Area public. Public open houses are planned for late 1991 to present the Stage I information and the PAC's definitions of problems and goals.

To facilitate public outreach, a fact sheet series has been produced along with a slide presentation, an exposition stand and a popular summary of the Stage I report.

St. Lawrence River

A Stage I report describing environmental conditions and problem definitions has been prepared for the Cornwall area of the St. Lawrence River. Input to the document has been received from the Public Advisory Committee, New York State, Quebec and the Mohawks at Akwesasne. The RAP Team has submitted the report to the COA RAP Steering Committee and the PAC for final comment prior to transmittal to the International Joint Commission.

The report highlights the local concerns in the St. Lawrence River and places emphasis on issues related to: mercury contamination in sediments and fish; other contaminants (PCBs, chlorinated phenols, heavy metals etc.) in water, sediments and biota; excessive aquatic weed growth; fish and wildlife habitat; and bacteria levels.

To further quantify impairments, and develop recommendations for remedial action, a number of specific studies were undertaken in the 90/91 field season relating to priority areas for source control of bacteria, mercury and fish tainting compounds. Ongoing studies in the area of concern include: sport fish and spottail shiner contaminant monitoring, low level contaminant water quality and suspended solids monitoring, dispersion modelling and current profiling, urban runoff studies, fish tumour assessment, indigenous mussel and wildlife contaminant levels.

In response to community concerns regarding human health as affected by water quality, a preliminary estimation of fish and wildlife consumption rates and exposure is planned for 91/92. Further evaluation of health risk and the relative significance of exposure rates, particularly within the native community, will fall under a basin-wide evaluation co-ordinated by Health and Welfare Canada.

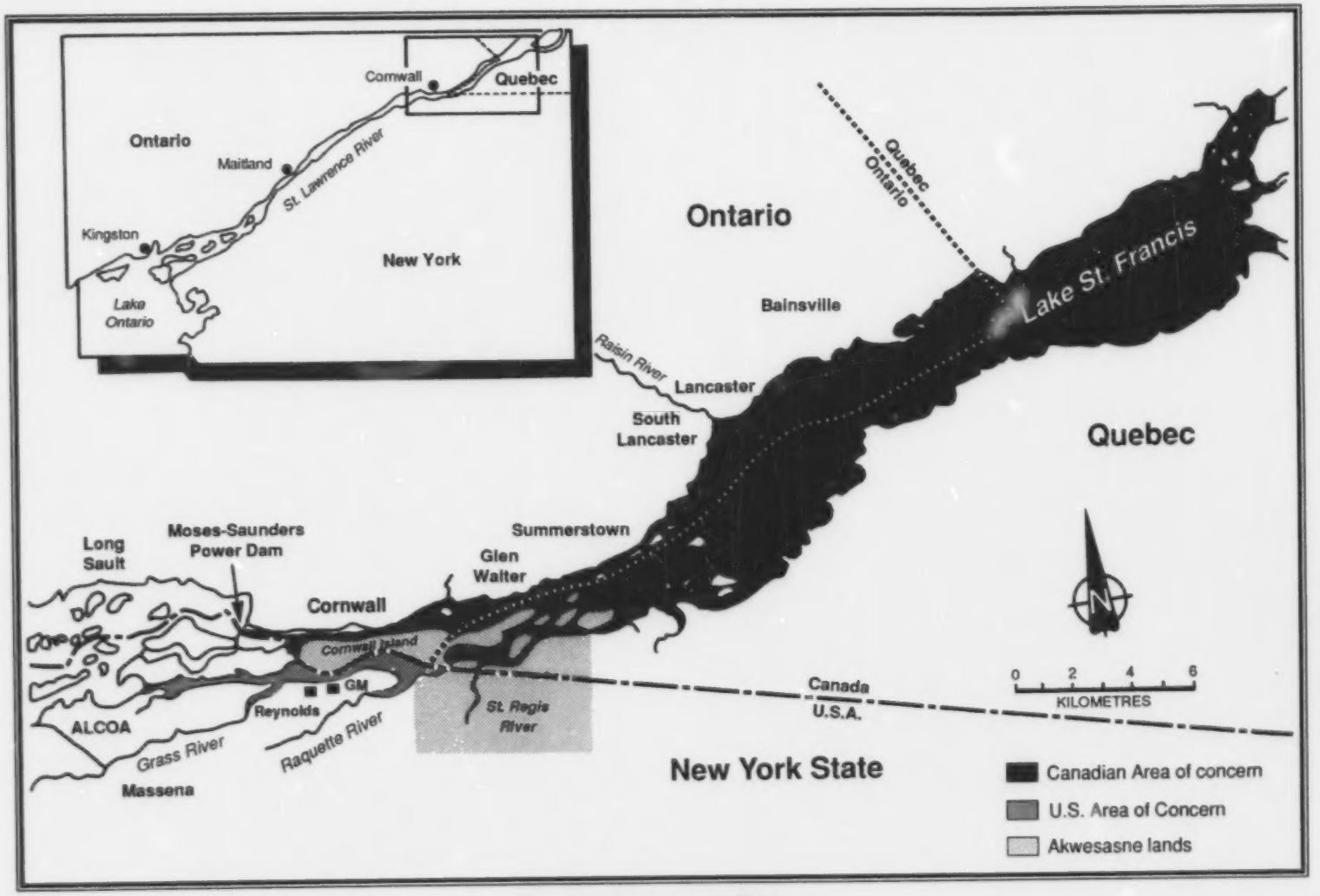
RAP investigations of PCB levels in fish (sport fish and young-of- the-year spottail shiners) in 1988 and 1989 have indicated an increase in the availability of PCBs to the biota in the section of the River adjacent to the General Motors Central Foundry in Massena, New York. The evidence of increasing concentrations in fish further supports the potential for transboundary impacts and points to the need for specific and immediate action to reduce PCB sources and remediate sediments on the U.S. side of the River. Co-ordinated monitoring activities before, during and after cleanup work is a goal of all parties in the St. Lawrence River Area of Concern.

RAP development activities have shifted to the identification of remedial options to address the impacts on the aquatic environment. Source control and ecosystem management alternatives are under discussion to approach a consensus on priorities and effectiveness of various options and combinations of options. A workshop is scheduled for early March, 1991, to discuss the technical feasibility and effectiveness of options relating to industrial wastewater, stormwater, contaminated sediments and habitat restoration. An options discussion paper is being drafted in consultation with the Public Advisory Committee and will be presented to the broader public for information and consensus on preferred options in the summer and fall of 1991.

In the absence of a binational RAP, a joint goal statement for the Cornwall and Massena RAPs has been produced and agreed to by Canadian and U.S. agencies who are responsible for the preparation of the RAPs as well as both Canadian and U.S. Advisory Committees. The Governments of Quebec and the Mohawks of Akwesasne have also agreed to the statement as follows:

> *"The goal of the Cornwall and Massena Remedial Action Plans is to restore, protect, and maintain the chemical, physical, and biological integrity of the St. Lawrence River ecosystem, and in particular the Akwesasne, Cornwall - Lake St. Francis and Massena Areas of Concern in accordance with the Great Lakes Water Quality Agreement."*

To fulfil the commitment between the agencies to develop a joint statement of the problem for the Cornwall and Massena areas of concern, a draft document has been prepared and is under review. This document summarizes both Stage I reports describing environmental conditions and sources and also sets the stage for future joint activities thereby linking the two separate RAP processes more closely. The joint summary report will be made available to a wide distribution list on both sides of the river.



St. Lawrence River Area of Concern

Public Involvement

Public interest in the Remedial Action Plan development in Cornwall remains high with regular monthly Public Advisory Committee meetings and numerous subcommittee activities. The PAC has been actively involved in reviewing SUPERFUND proposals for the General Motors Central Foundry and the Aluminum Company of America (ALCOA) in Massena, New York. Participation in local trade shows, a fish tainting evaluation study, sponsoring of workshops and the establishment of a store-front PAC Resource Centre with a full-time staff of four are all positive accomplishments of a concerned and dedicated community.

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Lake Ontario Toxics Management Plan

The Niagara River Declaration of Intent, signed by the Four Parties in February, 1987, included a commitment to develop a toxics management plan for Lake Ontario. The draft Lake Ontario Toxics Management Plan (LOTMP) was tabled in January, 1988, and finalized after extensive public consultation in February, 1989.

The far-reaching goal of the Plan is a Lake that provides drinking water and fish that are safe for unlimited human consumption, and that allows natural reproduction of the most sensitive native species. Towards the achievement of this goal, the Plan calls for the development of preliminary load reduction targets by March, 1990 (overdue), and final load reduction targets by 1994. Four objectives are to contribute to meeting the load reduction targets identified. These are: (1) reduction in toxic inputs driven by existing and developing agency programs; (2) reduction in toxic inputs driven by special efforts in geographic Areas of Concern; (3) further reductions in toxic inputs driven by lakewide analysis of the fate of pollutants, which is to be conducted under the LOTMP; and (4) zero discharge. On December 10th and 13th, 1990, the LOTMP Secretariat held a workshop to discuss the status of the updated draft LOTMP.

Lakewide Management Plans

One of the important changes in the 1987 Protocol amending the Great Lakes Water Quality Agreement was a new provision calling for the development and implementation of Lakewide Management Plans (LAMPs) as a means of reducing the levels of designated Critical Pollutants in open lake waters. Specifically, Annex 2 of the Agreement requires that Canada and the United States along with provincial and state governments, develop and implement LAMPs for open waters, except for Lake Michigan where the United States has sole responsibility.

The need for a LAMP became increasingly apparent as a result of widespread fish consumption advisories and evidence of toxic pollution in the open waters of the Great Lakes. Furthermore, it was recognized that a multi-media, multi-source and multi-jurisdictional approach, similar to the lakewide phosphorus reduction plans, would be necessary to address the problems of the open waters. As with phosphorus, it was recognized that the LAMPs for Critical Pollutants should focus on the total loadings to the Lakes and impairments resulting from chronic exposure to low levels of pollution. They are to integrate programs and measures addressing the

more acute problems of the localized Areas of Concern with the need for lakewide protection.

By adopting this new integrated approach to toxic pollution, it is the intent of both countries that LAMPs will address Critical Pollutants as well as advance the broad range of activities and goals of the Great Lakes Water Quality Agreement. In that regard, LAMPs for Critical Pollutants will serve as an important step in achieving zero discharge and virtual elimination of persistent toxic substances. Faced with the situation of persistent toxic substances in the Great Lakes ecosystem, the governments of Canada and the United States concluded that the only course of action was to adopt a policy of virtual elimination of the discharge of these substances to the environment. Furthermore, they concluded that pollution control programs should incorporate into their design the philosophy of zero pollutants added to the discharge. This principle was later established by the two governments when the 1978 Great Lakes Water Quality Agreement was signed, and further confirmed in the 1987 Protocol.

The Government of Canada reaffirmed this policy by adopting virtual elimination as a national goal in its Green Plan. To achieve virtual elimination, the Green Plan commits Canada to work with the United States on the development of a bilateral action plan for comprehensive pollution prevention in the Great Lakes Basin. The federal government will also commit funding for technology demonstration and community education projects to support pollution prevention action plans.

The Ontario Ministry of the Environment has in place a strong regulatory process involving control orders, certificates of approval and inspection and prosecution mechanisms. The purpose of the Municipal-Industrial Strategy for Abatement (MISA) is to regulate the discharge of both persistent toxic chemicals and conventional substances from effluents to the point where they are virtually eliminated from the environment.

Discussions are under way with the U.S. Environmental Protection Agency on specific programs to address the issues of zero discharge and virtual elimination for Lake Superior.

LAMPs will be measured not only by the effect they have on reducing loadings of Critical Pollutants in the respective Lake Basins but also on the extent to which they contribute to meeting the ecosystem objective of the Great Lakes Water Quality Agreement.

The involvement of the public in these activities has been in the form of workshops. A public workshop was held in April, 1989, to discuss public input into a Canada/United States framework for Critical Pollutants in Lakewide Management Plans. The Parties subsequently developed a *Framework for Lakewide Management Plans for Critical Pollutants*, incorporating input received at a second public workshop held November 17, 1989, in Toronto. The Framework provides a clear and detailed articulation of the requirements for LAMPs based upon the outline provided under Annex 2 of the Great Lakes Water Quality Agreement. The Framework was signed by the Parties (Canada and the United States) and distributed to the interested public on April 4, 1990.

The Parties have also developed *Lakewide Management Plan Review Criteria*. These criteria will serve as a guide to the authors of LAMPs. By posing a number of questions that will be the focus of the Parties' review of the individual LAMP documents, the criteria identify key elements which must be incorporated into the LAMP.

The Parties have agreed to review resource needs and work elements for a Lake Ontario LAMP while work on the LOTMP continues.

The Parties have also initiated studies which will lead to the establishment of a Critical Pollutants List for Lake Ontario.

Environment Canada is leading an assessment of the first 13 beneficial use impairments identified in Annex 2 of the Great Lakes Water Quality Agreement and their causal relationship to levels of pollutants in the Lake Ontario ecosystem. The United States Environmental Protection Agency is assessing the loss of fish and wildlife habitat. The results of both studies will be subjected to extensive public consultation prior to the Parties reaching a final decision on the Critical Pollutants List.

A workshop, held on December 12, 1990, initiated discussions regarding the mass balance effort required in support of a Lake Ontario LAMP. The LAMP process utilizes the mass balance approach as a tool in gathering and analyzing information on concentrations, sources and pathways of Critical Pollutants. Initial discussions have focused on the information requirements of the decision-making processes which establish pollutant reduction and elimination strategies, in an effort to determine the size and complexity of the mass balance effort required. Commencement of field studies is projected for 1992.

In the Framework, the Parties addressed several points from the workshops and expressed their intent to establish advisory councils comprised of representatives of the United States and Canadian public and private sector organizations, including non-profit organizations having an interest in the development and implementation of Lakewide Management Plans. The councils will provide important input and advice to the LAMPs working committees from the inception of the Lakewide

Management Planning process through implementation.

It is also the Parties' intent that public meetings and information workshops be held at appropriate stages during the development and implementation of the plans at sites around each Lake Basin. At a minimum, public meetings will be held to correspond with the four review stages called for in Annex 2 of the Agreement. These are:

- problem definition;
- determination of a schedule of load reductions;
- selection of remedial measures; and
- elimination of the impairment of identified beneficial uses by Critical Pollutants.

LAMPs will require information in the relative significance of the sources and fate of each contaminant of concern. A mathematical model, TOXFATE, was developed for Lake Ontario at the National Water Research Institute (NWRI) for these types of applications.

The predictive capacity of the contaminant fate model, TOXFATE, was verified using new field data on PCB concentrations in the Lake Ontario system. This model accurately relates loadings to concentrations of PCBs in water, sediment and fish and predicts the responsiveness of the Lake to various loading scenarios. In subsequent research, the TOXFATE model was coupled with the hydrodynamic model, RAND, to describe the fate of contaminants entering Lake Ontario from sources at the Toronto waterfront. Based on data for the late 1980s, inputs of organic contaminants from the Toronto area represent approximately 0.5% to 25% of the loading from the Niagara River to the Lake. As controls and abatement programs are implemented on the Niagara River, its loadings will decrease, which in turn will increase the relative significance of other sources including the Toronto area. On average once every ten to fifteen days, currents and upwellings facilitate the replacement of the water mass along the Toronto waterfront area with fresh lake water.

The National Water Research Institute has initiated planning for a potential, integrated ecosystem study of Lake Ontario, beginning in 1992, in support of a lakewide management plan.

Basinwide Wildlife Monitoring

Herring gull eggs were collected from thirteen annual monitoring colonies spread over the five Great Lakes as part of the ongoing contaminants monitoring program of the open lake ecosystem. Analysis for PCBs, organochlorine pesticides, dioxins and furans were performed on eggs from all sites.

By comparing concentrations of six compounds in herring gull eggs from thirteen sites for 1989 and 1990, it was found that: 55% of the contaminants measured decreased by 10% or more, 23% showed no change, and 22% increased. During the last four years (1987-1990), concentrations of DDE, HCB, and total PCBs from all thirteen monitoring sites were at their lowest levels since the monitoring program started in 1971. Dieldrin and mirex were at their lowest concentrations at twelve of thirteen sites. Eight of thirteen sites reached their lowest levels of 2,3,7,8-TCDD during 1987-1990. The 1987-1990 period was thus characterized by continued low levels and nearly all contaminant levels were reduced to their lowest levels since the herring gull monitoring program began.

Studies of incidences of deformities in Double-crested cormorants were conducted on the Canadian and American Great Lakes. Approximately 19,000 cormorant chicks were examined on the Canadian Great Lakes and 4 chicks with deformed bills were found. Studies of deformities in developing embryos in cormorant eggs from the eastern Lake Ontario area areas found that 88% of 397 eggs examined had normal, healthy chicks present. From 1989 to 1990, the number of cormorant nests in Lake Ontario decreased from approximately 5,900 to 6,700, an increase of approximately 13 per cent.

In 1989, a census of herring gull nests in Lake Huron found a 28% decline in total numbers of nests since 1980. Numbers of nests had decreased the most in the central and south basins of Lake Huron, and remained stable in Georgian Bay, most of Huronia and the St. Marys River. Food availability appeared to be an important factor contributing to the changes in herring gull population size.

As part of a 1990 study on contaminants in wild foods in Ontario, collections of wild ducks were made from 10 sites of migration on the Great Lakes shoreline.

ANNEX 3:
Control of Phosphorus

The purpose of Annex 3 is to minimize eutrophication problems and to prevent degradation with regard to phosphorus in the boundary waters of the Great Lakes System. The Parties, in accordance with Annex 3 and its supplement, are required to undertake the following in co-operation with state and provincial Governments:

i) develop and implement programs to reduce input of phosphorus to the Great Lakes;

ii) establish load allocations and compliance schedules;

iii) develop and implement phosphorus load reduction plans; and

iv) develop and implement the following phosphorus control programs:

   a. Municipal Waste Treatment Facilities,
   b. Detergent Phosphorus Limitation,
   c. Industrial Discharges,
   d. Non-point Source Programs and Measures,
   e. Research, and
   f. Surveillance and Monitoring.

Established in 1985 under the auspices of the Canada-Ontario Agreement Respecting Great Lakes Water Quality, the Non-Point Source Committee has continued to monitor and report on the progress of programs and activities under Annex 3 and its Supplement. Environment Canada, the Ontario Ministry of Environment, Agriculture Canada, Fisheries and Oceans Canada, the Ontario Ministry of Agriculture and Food and the Ontario Ministry of Natural Resources are represented on the Committee which is co-chaired by the two environmental agencies.

Phosphorus Load Reduction Plan

The Canadian Phosphorus Load Reduction Plan has the following objectives:

Lake Erie Basin

The objective for the Lake Erie Basin is a reduction of 300 tonnes per year (mta). This will be comprised of 100 mta from municipal and industrial sources and 200 mta from agricultural sources.

The Soil and Water Environmental Enhancement Program (SWEEP) has the 200 mta reduction as one of its main objectives.

Lake Ontario Basin

The Load Reduction Plan for the Lake Ontario Basin calls for the continuation of existing programs and the voluntary adoption of conservation tillage and cropping by farmers in the Basin, while Lake Ontario continues to respond to the massive phosphorus reductions already achieved. Current surveillance data indicate that the target in-lake concentration of phosphorus (10 micrograms/litre) has been achieved.

Upper Great Lakes Basin

The Load Reduction to the Upper Great Lakes Basin is to be achieved by limiting the effluent phosphorus concentration to 1 mg/L for all Municipal Sewage Treatment Plants that discharge more than 1 million imperial gallons per day (mgd).

The Supplementary Agreement requires that surveillance , monitoring and modelling be conducted to provide improved estimates of loadings and to enable monitoring of progress.

Municipal-Industrial Control Programs

Each year, the Province of Ontario reports on discharges of phosphorus in municipal and industrial point sources to the Great Lakes. Reductions of phosphorus to the Lower Great Lakes Basin have been specified in the Supplement to Annex 3.

Municipal Waste Treatment Facilities

Municipal point source loading data for 1988 and 1989 are compared in *Table II*. Overall, the total phosphorus loading to Lake Erie from municipal point sources increased by 8.1 tonnes/year in 1989, which represents a 3.8% increase over that of the previous year. The total phosphorus loading to the Lake Ontario Basin from Ontario plants increased by 6.1 tonnes/year in 1989, which is an increase of less than 1% over 1988 loadings.

Compliance of plants with phosphorus removal requirements showed substantial improvement in 1988

TABLE II

Comparison of 1988 and 1989 Ontario Municipal Point Source Discharges to the Lower Lakes*

Lake	Year	Flow m3/d	Total P Avg (mg/L)	Conc'n Flow-Wt (mg/L)	Total P Load (t/yr)
ERIE	1988	857,700	0.65	0.68	206
	1989	871,800	0.55	0.69	214
	% Change	1.6	-18.2	1.5	3.8
ONTARIO	1988	2,810,000	0.84	0.70	721
	1989	2,960,000	0.87	0.67	727
	% Change	5.0	3.5	-4.5	0.84

* 1983 Base Year Municipal Point Source Loads are: Lake Erie 251 t/yr; Lake Ontario 887 t/yr.

TABLE III

Compliance with Phosphorus Control Requirements*

	1987	1988	1989
No. of Plants	103	115	115
No. in Compliance	55	73	76
% Compliance	53	63	66

* Includes plants with capacities equal to or greater than 1 million gallons per day.

and 1989 compared to 1986-87. While the number of plants of capacities greater than 1 million imperial gallons per day with phosphorus removal requirements increased to 115, compliance rates increased to 63% in 1988 and 66% in 1989, as shown in *Table III*.

Phosphorus Detergent Limitations

Under the Canadian Environmental Protection Act (CEPA), regulations were issued in November, 1989, prescribing the maximum concentrations of phosphorus permitted in laundry detergents. CEPA also allows regulations to be developed for a broader range of products such as cleaning agents and water conditioners.

Canada continues to control the level of phosphorus in detergents using the Phosphorus Concentration Regulations under the Canadian Environmental Protection Act. This legislation limits phosphorus concentration in detergents to 2.2%. Monitoring of all detergent manufacturers in Canada is conducted to ensure compliance with the regulations.

Industrial Waste Treatment Facilities

Industrial point source loadings to Lake Erie in 1988 and 1989 are compared in *Table IV*. The overall loading was reduced by 11.9 tonnes/year to 8.9 tonnes/year. This was principally due to reductions of the nutrient of the CIL fertilizer plant at Courtright. In addition, phosphorus loads from the Heinz plant are now assessed in the municipal load discharged by the Leamington STP, rather than as an industrial point source discharge.

In the Lake Ontario Basin, industrial phosphorus loadings declined by 1.8 tonnes/year to 12.5 tonnes/year. The reduction resulted from significantly reduced phosphorus concentrations at the Canadian Canners plant (which operates on a short seasonal basis), and also from assessing the Ford Motor Co. plant as a contributor to the municipal discharge rather than as an industrial point source discharge.

Phosphorus Non-Point Sources: Programs and Measures

Rural Non-Point Sources

The Canada-Ontario Agreement on Southwestern Ontario Soil and Water Quality Enhancement was formally signed in May, 1986, to implement a program that addresses the reduction of phosphorus loads from agri-

TABLE IV

Comparison of 1987 and 1989 Ontario Industrial Point Source Discharges to Lake Erie (tonnes/year)*

Company	1987	1989	Diff. '89-'87
Campbell Soup Company Ltd. St. Mary's	0.96	1.56	0.60
Canadian Industries Ltd. Courtright	10.6	1.43	-9.17
Ford Motor Company St. Thomas	0.92	0.29	-0.63
H.J. Heinz Co. of Canada Leamington	3.58	#	-3.58
International Minerals & Chemical Corp. Dunville	0.95	0.62	-0.33
J.M. Schneider Inc. Ayr	0.30	0.01	-0.29
Omstead Food Ltd. Wheatley	1.14	0.60	-0.54
Stelco Inc., Lake Erie Works Nanticoke	1.52	3.99	2.47
Tend-R-Fresh Poultry Ltd. Nanticoke	0.51	0.12	-0.39
Novacor Chemicals Ltd. Corunna	0.25	0.15	-0.10
Ontario Hydro Nanticoke	0.08	0.15	0.07
TOTAL	20.8	8.9	-11.9

\# Discharges to Leamington STP
* 1983 Base Year Industrial Point Source Load: 28 tonnes/year

cultural non-point sources for the Lake Erie Basin. The program, known as the Soil and Water Environmental Enhancement Program (SWEEP), which is delivered by federal and provincial agencies and provides funding of $30 million over the period 1985-1993, combined incentive programs, education, and research.

The Land Stewardship Program of the Ontario Ministry of Agriculture and Food which was introduced in 1987 (and expired August 31, 1990) also addressed reduction of phosphorus through adoption of conservation farming practices. This program is discussed further in Annex 13.

Soil and Water Environmental Enhancement Program (SWEEP)

As of December, 1990, the SWEEP Program will have been in place for over four years. The program, through a variety of approaches, is responsible for meeting the commitment to reduce phosphorus loadings by 200 tonnes/year from non-point sources in the Lake Erie Basin.

There are three federal, three provincial and three joint federal-provincial program components which are contributing to the goals of the SWEEP program. Due to delays in start-up, the federal components under Agriculture Canada have been extended through an amending agreement to March 31, 1993. The provincial programs under the Ontario Ministry of Agriculture and

TABLE V

Summary of Expenditures under the SWEEP Agreement 1985 to 1990 ($ millions)

Programs	Fiscal Years 85/86	86/87	87/88	88/89	89/90	1985-1990
Sub-Program *1 Technical Assessment Panel Conservation Info Bureau Social-Economic Evaluation	0.01	0.11	0.12	0.16	0.21	0.61
Sub-Program 2* Farm Level Economic Analysis Technology Evaluation & Development	0.35	0.22	0.50	1.26	1.67	4.00
Sub-Program 3* Pilot Watershed Studies	0.22	0.02	0.66	1.46	0.97	3.33
Sub-Program 4# Local Demonstration	0.45	0.38	0.36	0.41	0.35	1.95
Sub-Program 5# Technical Assistance	1.11	1.02	1.02	1.05	1.01	5.21
Sub-Program 6# Soil Conservation Incentives	0.62	0.58	1.25	3.43	2.28	8.16
Sub-Program 7* Administration, Monitoring and Public Information	0.05	1.11	0.15	0.23	0.22	0.76
Sub-Program 7# Administration, Monitoring and Public Information	0.00	0.06	0.04	0.08	0.07	0.25
TOTAL	2.81	2.50	4.10	8.08	6.78	24.27

* denotes federal sub-program
\# denotes provincial sub-program

Food, were completed as of March 31, 1990. Federal and provincial expenditures under the SWEEP Agreement as of March 31, 1990, are depicted in *Table V*.

A description of the SWEEP sub-programs and highlights of their progress up to 1990 follows.

SUB-PROGRAM 1: Conservation Technology and Techniques

The purpose of this sub-program is to stimulate adoption of the soil management and cropping practices in the Lake Erie Basin required to improve water quality and reduce soil erosion and degradation. This can be achieved by assessing technology, interpreting and communicating information, and identifying required public policies and programs.

a) ***Technology Assessment Panel (TAP)***

On an annual basis, the Technology Assessment Panel has provided to the SWEEP Management Committee a review of the annual implementation plans of each federal and provincial sub-program. Other activities have included a number of fact-finding tours to research sites in both Canada and the United States, to assess both new and existing conservation farming technologies for further evaluation and development. In addition to these activities, this expert panel of fifteen farmers, academics, industry representatives and government officials have reviewed ten completed SWEEP research reports to ensure they are of high calibre and technical merit.

b) ***Conservation Information Bureau (CIB)***

On March 3, 1989, a contribution agreement was signed between Agriculture Canada and the University of Guelph to establish the Conservation Information Bureau in conjunction with the University's Centre for Soil and Water Conservation. To date, the Bureau has compiled a computerized database of research on soil and water conservation and agricultural conservation technologies and systems. Four issues of the Bureau's newsletter, titled "InfoSource" have been produced and distributed to 7,000 farm subscribers in Ontario. A total of $1 million is being provided through the federal SWEEP program to fund the initial start up and operation of the Bureau for four years. Currently, the Bureau's advisory committee is reviewing ways and means to fund the Bureau beyond the lifetime of the SWEEP Agreement.

c) ***Socio-Economic Evaluation (SEE)***

Funds were provided, under the Socio-Economic Evaluation component, to graduate students to conduct agricultural research on the socio-economic factors associated with the adoption of soil and water conservation practices and measures. To date, a total of five research studies were completed under this SWEEP component. The titles of the completed studies are as follows:

- *Tillage 2000 and Its Effect on Awareness of Conservation Tillage*
- *An Economic Assessment of the Distribution of Benefits Arising from the Adoption of Conservation Tillage Practices in Crop Production in Southwestern Ontario*
- *Sources of Motivation in the Adoption of Conservation Tillage*
- *Social Structure and the Choice of Cropping Technology: Influence of Personal Networks on the Decision to Adopt Conservation Tillage*
- *Conservation Practices in Southwestern Ontario Agriculture: Barriers to Adoption*

Recently, the structure of this research program was changed to allow the involvement of the private sector in a competitive tendering process. In 1990, a major research study to prepare an annotated bibliography of recent North American research which identifies the socio-economic factors involved in the adoption of soil and water conservation practices was completed. Research to be conducted over the next two years will focus on the research gaps identified in this study.

SUB-PROGRAM 2

The purpose of this sub-program is to develop and test technologies and technology systems that have a high probability of being successful in commercial farms. In general, testing of these technologies will occur under commercial farm conditions in priority areas in co-operation with commercial farmers. The technologies or technology systems will be evaluated for their impact on soil quality and crop production, and on economic benefits and costs.

a) ***Technology Evaluation and Development (TED)***

To date, a total of five research studies have been completed under the Technology Evaluation and Development Sub-Program. Another twelve research studies are complete and in the draft report/review/revision stage. Finally, thirty other research projects are currently under way. The titles of the five completed reports are as follows:

- *A review of Farm Based Soil Conservation Research*
- *Assessment of Soil Compaction and Structural Degradation in the Lowland Clay Soils*
- *Conservation Tillage Handbook, Equipment Modifications and Practical Tips for Use*
- *Rainfall Simulation to Evaluate Erosion Control*
- *Choice and Management of Cover Crop Species and Varieties for Use in Row Crop Dominant Rotations*

b) ***Farm Level Economic Analysis (FLEA)***

While problems were initially encountered in collecting farm level economic data to conduct an assessment of conservation farming technologies and systems, the consulting firm of Deloitte and Touche, Guelph, was able to conduct, in 1989 and 1990, analyses of the provincial Tillage 2000 program. Results from the analyses are heartening. In 1990, analysis revealed that no till and reduced tillage practices incorporated in the Tillage 2000 program are competitive with conventional practices in corn and winter wheat. In addition, no till practices provide producers with realistic potential for significant labour savings when used in corn. No till cropping operations, therefore, are particularly advantageous for farmers with high opportunity costs to labour.

SUB-PROGRAM 3: Pilot Demonstration Watersheds

The purpose of this sub-program is to develop approaches to evaluate the effectiveness of implementing comprehensive soil and water conservation practices on all farms in a watershed. The effects of these practices in treated watersheds will be compared to three control watersheds. Both the treatment and the control watersheds will be evaluated for the impacts on water quality, soil quality, crop production and economic costs and returns. The approaches used to implement the program

on the watersheds, as well as the social considerations and consequences will be documented and evaluated.

By the end of 1990, two complete years of cropping information had been obtained from the three pairs of pilot demonstration watersheds. While drought conditions affected all the watersheds in 1989, precipitation in 1990 was well above normal.

The environmental agencies are participating in this study by providing environmental monitoring at the mouth of the sub-watersheds. The Ontario Ministry of the Environment has provided an event oriented water quality monitoring program as well as meteorological monitoring in each watershed. Environment Canada has provided monitoring facilities and equipment shelters, and maintains a streamflow monitoring program.

By the end of 1990, two complete years of environmental data had been obtained from the three pairs of watersheds. The streamflow records, in concert with water quality information, will allow the estimation of suspended solids and phosphorus loadings on an event, seasonal and annual basis.

SUB-PROGRAM 4: Local Demonstrations

The goal of this program is to promote the wider adoption of proven soil and water conservation technology on agricultural land. The focus is on soil and crop management practices, primarily tillage and crop rotations. The demonstrations provide farmers with first-hand information on how to use the practice, its benefits, problems, and resultant changes in crop yield, soil structure and erosion. The economic aspects of alternative systems is useful for assisting farmers in making decisions on the selection of a conservation management practice for their farm.

a) ***Tillage 2000***

Results indicate that corn yields obtained with conservation tillage are similar to yields obtained through conventional tillage methods. Soybean yields with conservation tillage were lower than with conventional methods, but savings of preharvest time offset some of the yield disadvantage. Soil losses with conventional tillage were greater than soil losses where conservation tillage was used.

Of the 42 Tillage 2000 sites, 29 were located in the SWEEP target area. In addition to yield and crop residue data, 15 sites were sampled for cesium and five sites were surveyed by Dr. G. Kachanoski, of the University of Guelph, to provide a three-dimensional data model of each benchmark.

b) ***Side-by-Side Demonstrations***

These consist of comparative local on-farm demonstrations to promote soil and water conservation techniques thereby providing farmers in the area with first hand information on how to implement conservation practices.

Conservation tillage yield results were generally comparable to conventional tillage plots, except where there were problems with weed control and drought conditions. Within the SWEEP target area, up to 160 side-by-side conservation tillage comparisons were established.

SUB-PROGRAM 5: Technical Assistance

The goal of this sub-program is key to the achievement of the non- point phosphorus load reduction target for Lake Erie: to assist in instituting the required best management practices on 8,000 farms, covering 400,000 hectares, in order to obtain the necessary reduction in soil loss. It provides farm level conservation advice by utilizing a professional team with expertise in soils and crops, soil and water engineering, and farm management.

Numerous technical workshops and meetings were held in the SWEEP area. These included conservation education meetings, educational courses, conservation farming updates, practical conservation tillage seminars, no-till workshops, conservation tillage equipment days, Ridgetown College of Agricultural Technology Soil and Water Management Days, and activities in co-operation with the Ontario Soil and Crop Improvement Association (OSCIA).

Information was provided to the agricultural community through Ontario Ministry of Agriculture and Food News feature articles, newsletters, local news releases and two special publications titled "Down to Earth" and "Conserving Your Soil". Six conservation related Factsheets were published and another six more were in final draft form. The Conservation Tillage Handbook was printed, distributed and translated in French, with an additional second printing. OSCIA publications, newsletters and annual reports which contained conservation farming information were also distributed. A poster featuring soil conservation was produced and mailed to schools in southwestern Ontario.

Liaison, communication and co-operation with other agencies and agribusiness continued. Joint soil and water conservation programs with 12 Conservation Authorities were renewed. Several county tillage competitions were held to encourage conservation methods. At the International Ploughing Match and Farm Machinery Show, conservation tillage was demon-

strated and a conservation services tent was staffed through the co-operation of various government agencies. Three conservation clubs were established. An OMAF conservation tour was organized and articles prepared for the farm press.

Conservation Farming '88, a major demonstration event organized by OMAF and several other agencies, was held for two days in June 1988. Approximately 5,000 people attended this exhibition of conservation methods, equipment and technology in Woodstock, Ontario. AgriVision, a co-operative program with Ciba-Geigy about conservation tillage, was held in July, 1988.

SUB-PROGRAM 6: Soil and Water Conservation Incentive Grants

Soil and water conservation incentive grants available in the SWEEP area, and throughout Ontario, assist farmers with the installation of structural soil erosion control measures and environmentally appropriate animal waste and pesticide handling practices. This assistance program, known as the Ontario Soil Conservation and Environmental Protection Assistance Program II (OSCEPAP II), provide grants for two thirds of the cost of structural erosion control measures to a maximum of $10,000. For environmental protection, grants of 40% of the cost of manure, milkhouse waste, and pesticide management projects were also available up to a maximum of $7,500. The OSCEPAP II, OMAF's primary contribution to SWEEP, ended March 31, 1990.

SUB-PROGRAM 7: Administration, Monitoring and Communications

The purpose of this sub-program is to ensure that all sub-programs are co-ordinated on a day-to-day basis and are contributing to the objectives of the Program in a timely, efficient and cost effective manner. The Public Information component facilitates the generation of positive public and farm support, encouraging early and active involvement in the Program and sustained interest over its lifespan.

a) *Administration*

Administration of the SWEEP program has progressed smoothly under the direction of the SWEEP Management Committee. Members of the Management Committee represent the four signatory agencies of the SWEEP Agreement - the Ontario Ministry of Agriculture and Food, Agriculture Canada, the Ontario Ministry of the Environment and Environment Canada. As required under the Agreement, a SWEEP Annual Report was prepared for each year the program has been operating.

b) *Monitoring*

Following the preparation of a plan to evaluate the SWEEP program upon its completion, an annual review of the SWEEP program and its activities was conducted. Based on these reviews, the SWEEP Management Committee, where required, has taken corrective action to improve program or project delivery.

A second major thrust is a survey of "Cropping, Tillage and Land Management Practices in Southwestern Ontario". This detailed baseline study was conducted on 1,115 farms in 1986. In 1991, a second survey will be done on the same farms to measure on-farm changes and thus the impact of SWEEP.

c) *Public Information*

Following the development of an initial communications strategy for the SWEEP program a wide range of communication activities have been initiated. A SWEEP brochure was produced and is continually being distributed at major agricultural events in southwestern Ontario. A SWEEP newspaper is published on a quarterly basis, a SWEEP video was produced and is available at no charge to interested persons or organizations, and the SWEEP exhibit is displayed each year at twelve major agricultural events, including the Royal Agricultural Winter Fair, the Norfolk Country Fair, the Ontario Federation of Agriculture Annual Meeting and the Ontario Pork Congress.

Monitoring/Modelling Activities

The agricultural non-point source control practices being promoted by the programs and activities described under the SWEEP Program will all have an impact on phosphorus loading to the Lake Erie Basin. It has been decided that a modelling approach must be utilized to measure the required 200 tonne reduction in phosphorus loading.

Since the required phosphorus reduction is small relative to the total loadings and the annual variability is more than twice the magnitude of the required reduction, the change in phosphorus loading to the Lake Erie Basin is being assessed on the land, and not in the water.

The rationale and detailed activities required for the Lake Erie model has been developed and documented in an unpublished report titled *Non-Point Source Overview Model - Lake Erie Basin*. The modelling activity is being undertaken with two objectives:

Short Term - To evaluate Canada/Ontario progress in meeting the phosphorus loading reduction to the Lake Erie Basin called for in the Supplement; and

Long Term - to develop a long term database in order to determine "the extent of change in land-use and land management practices that significantly affect water quality for the purpose of tracking implementation of remedial measures and estimating associated changes in loading to the Lakes" (GLWQA-Annex 13).

The Non-Point Source Overview Model is based on three components:

i. Adoption - monitoring the change in implementation of the conservation practices on the land;

ii. Effectiveness - monitoring the effects (on sediments and phosphorus delivery) of the conservation practices of individual soils, slopes, climatic areas etc; and,

iii. Extrapolation - combining the results of i) and ii) above and extrapolating to the Lake Erie Basin.

Data from extension, demonstration, incentive, research, development and monitoring programs of SWEEP are being integrated and evaluated within a modelling framework.

Following the initial model development, a workshop for scientists, researchers, and management was held in November, 1990. The purpose of the workshop was to present the conceptual model and discuss its components, and to review all conservation programs and agricultural research in order to evaluate and further develop the model.

Toward the longer term goal, a Geographic Information System has been acquired and a digital map database for soils, land use, erosion, terrain capability and delivery in the Ontario portion of the Lake Erie Basin has been assembled.

Urban Non-Point Sources

Encouragement continues to be directed to urban municipalities to adopt the Urban Drainage Design Guidelines developed by the Province of Ontario through efforts of provincial ministries and the Conservation Authorities. Guidelines on Erosion and Sediment Control for urban construction sites are also provided to municipalities. The Ontario Ministry of Environment is currently developing the MISA Sewer Use Control Program which will require industries to develop a Best Management Practices (BMP) Plan for control of storm water runoff. Compliance with the BMP will prevent unnecessary discharges of contaminated water to storm sewers.

A detailed discussion of the overall progress in the control of Urban Non-Point Source Pollution is provided under Annex 13 - Pollution from Non-Point Sources.

Monitoring and Surveillance

Loading data developed from the streamflow monitoring network and the Ontario Provincial Water Quality Monitoring Network continue to provide the basis for the evaluation of phosphorus loading trends. Detailed higher frequency data on sediment, phosphorus and other parameters, including pesticide and chemical residues, are obtained for the mouth stations of major significant tributaries. Such data increases the precision of loading estimates and the ability to detect long term trends in loading.

A screening survey is being conducted at the outlets of the five largest Ontario tributaries to Lake Ontario in support of the Lake Ontario Toxics Management Plan. Water, suspended sediments and surficial bottom material are being examined for phosphorus and an extensive list of many previously unmeasured organic chemicals. The results will provide estimates of mass loadings and help focus future monitoring activity.

ANNEX 4:
Discharges of Oil and Hazardous Polluting Substances From Vessels

According to Annex 4 of the Great Lakes Water Quality Agreement, the Parties are required to adopt compatible regulations for the prevention of discharges into the Great Lakes system of harmful quantities of oil and hazardous polluting substances. In Canada, the Canadian Coast Guard is responsible for administering and enforcing regulations aimed at preventing discharges of oil and hazardous polluting substances from vessels and from marine terminals during ship loading and unloading operations. For the purpose of Annex 4, hazardous polluting substances refer to chemicals carried by ships in bulk or in packaged form. Under currently administered regulations, a zero discharge regime for operational oil and chemical discharges from ships applies. Coast Guard authority over loading and unloading terminals is generally deemed to terminate at the connection point between the ship's transfer hoses and the terminal manifold.

The zero discharge regime currently being applied for oil discharges must be considered as a theoretical concept, since oil is present in minute quantities in many substances, including coffee. In the absence of effective monitoring equipment, reliance is currently placed on a visible sheen criterion - approximated by an oil in water concentration of 15 parts per million (ppm).

Under the conditions of the "International Convention for the Prevention of Pollution from Ships, 1973" and its 1978 Protocol, (MARPOL 73/78), sea-going ships are now fitted with oily water separating equipment and oil content meters. In MARPOL waters, and within twelve miles from land, oil discharges from such ships must not exceed 15 ppm. The Great Lakes are excluded from the MARPOL Convention discharge standards on account of the Lakes' use as a principal source of fresh water for industrial and domestic purposes and because MARPOL permits much higher discharge limits when a ship is more than twelve miles offshore. Nevertheless, it was recognized that a self-regulating system of monitored oil discharges was preferable to reliance on a subjective visible sheen criterion, and would result in lower oil loading on the Lakes. Consequently, under the provisions of new regulations now being developed, to implement planned Canadian accession to MARPOL, MARPOL equipped vessels will be permitted to discharge oily water through their filtering equipment, provided that the oily content meter is set for a maximum oil content of 5 ppm and operates an alarm and automatic shut-off in the event that 5 ppm is exceeded. Five parts per million filtering equipment is considered within the range of existing marine technology. Concentrated sludge from the filtering equipment must still be discharged to shore reception facilities and, under the proposed new regulations, reception facility receipts will have to be available for inspection on demand. For the ships that are chemical carriers, the outright prohibition on discharges of chemical substances will be retained. Following discharge of their cargo, some chemical carriers will wash their cargo tanks and pump the washing residues to a shore reception facility, prior to ballasting the cargo tanks for their return journey. A low concentration of the previously carried chemical will remain in the ballast water. The new regulations will require that this ballast water not be discharged until the ship is outside the Great Lakes and beyond Canada's territorial sea. In the absence of an inspector on board every chemical tanker which had ballasted its cargo tanks following unloading in the Lakes, it would be difficult to ascertain with certainty that none of the ballast water had been discharged prior to the ship reaching open sea - over 1,000 miles away. Therefore, it would be very useful if maximum safe concentration levels of chemicals in ballast water could be set, prior to the ship leaving the unloading port. This would ensure that even if the ship were to discharge the ballast water within Canada's internal waters, no environmental harm would occur. The guidance of the Science Advisory and Water Quality Boards on permissable concentration levels for the various chemical substances carried in the Lakes by ship would be most helpful.

Ships carrying chemical substances in packaged forms - in freight containers, tank cars, tank trucks or other portable means - are governed by regulations based on the International Maritime Dangerous Goods (IMDG) Code. The IMDG Code has recently been amended to include a new marine pollutant category. Packaging, marking, labelling, stowing and reporting requirements of the IMDG Code are applied to all hazardous or polluting substances carried in packaged form.

Reception facilities for oil and chemical substances are provided at ports by terminal operators and private sector contractors. The locations, capacities, and other details of currently available reception facility services at Canadian Great Lakes' ports are listed in a recently

published directory, which was commissioned by the Coast Guard and is available at a cost of $10 per copy. This directory suggests that ports in the Great Lakes handling chemical cargoes are not particularly well served by reception facilities, although portable tank truck operators are often available to provide service upon request.

Radio communications between ships and shore traffic control systems are an important element ensuring the safety of navigation in the Great Lakes. In recognition of the fact that VHF Channel 16, the safety, distress and calling-in channel, was seriously overloaded, an amendment to the Great Lakes Radio Agreement was arranged between Canada and the United States to provide for the use of VHF Channel 13 as the dedicated bridge-to-bridge communication channel. Regulations implementing the use of VHF Channel 13 as the navigational bridge-to-bridge frequency entered into effect on February 1, 1990. In each annual joint report by the Canadian and United States Coast Guards, statistics on the number of oil and chemical spill incidents in the waters of the Great Lakes are reported from various sources. This leads to some duplication in the incident reports of the reporting authorities. Moreover, the format used to report incidents varies between authorities. Discussions have been held with the United States EPA, the Canadian Coast Guard, Environment Canada and the Ontario Ministry of the Environment to develop a standardized spill reporting format for future use. As a result of these discussions, a Regional Communications Pilot Project was implemented during 1990 by Environment Canada to standardize spill reporting procedures between the Canadian Coast Guard, the Ontario Ministry of the Environment and Environment Canada. Further information on the pilot project is contained in Annex 8.

Based upon statistics from the Joint Coast Guard's report for the past two years, there have been an average of 175 spills per year reported to the Canadian Coast Guard from all sources. Most of these were of a minor nature and required no cleanup response action. For a few larger spills, clean up action was initiated by the Canadian Coast Guard on three occasions in 1988 and two occasions in 1989. The Canadian Coast Guard also initiated enforcement investigations in 63 cases over the two years and charges were laid against eight ships as a result of these investigations.

Possibly the most significant spill in the Canadian waters on the Great Lakes during the past two years involved tanker TOVE COB. This vessel sustained bottom damage when she settled on her own anchor at Clarkson, Ontario, releasing approximately 180 metric tons of tallow from a pierced cargo tank. Cleanup action was successfully undertaken by the Coast Guard. It should be noted that tallow, which is processed animal fat, is not listed in Appendix 1 as a hazardous polluting substance but is rated as a category D pollutant under Annex 2 of the International Convention for the Prevention of Pollution from Ships 1973 and its 1978 Protocol (MARPOL 73/78).

ANNEX 5:
Discharges of Vessel Wastes

Annex 5 of the Agreement confers upon the Coast Guard the responsibility for controlling the discharge of garbage, sewage and waste water from vessels into the Great Lakes system.

Within the Canadian waters of the Great Lakes, sewage controls are administered for pleasure craft by the Ontario Ministry of the Environment. Federal sewage pollution prevention regulations for pleasure craft will shortly be introduced for any water body within Canada, as designated by the relevant provincial government. The proposed federal regulations are similar to those currently administered by the Ontario provincial authorities, but the Ontario regulations will continue to apply, without challenge by the federal government, notwithstanding the existence of the federal pleasure craft sewage regulations.

In the case of commercial vessels, the federal government's *Great Lakes Sewage Pollution Prevention Regulations* apply. Ships operating in the Canadian waters of the Great Lakes are required to be fitted with a holding tank or an approved Marine Sanitation Device (MSD). Approved MSDs must process sewage such that the discharged effluent contains no more than the International Marine Organization's MARPOL standard of 50 mg/L of suspended solids and Biochemical Oxygen Demand (BOD), and a faecal coliform content not exceeding 250 per 100 mL of effluent. In addition, if chlorine disinfection is used, the residual chlorine content of the effluent must fall between 0.5 mg/L and 1.0 mg/L after the chlorine has been in contact with the sewage for 30 minutes or more. To ensure that these conditions are met, the regulations require that the approved MSDs be fitted with a monitoring device. An amendment to the federal regulations, now being processed, will allow periodic testing of MSD effluent as an alternative to fitting a monitor. This alternative is necessary to ensure equipment compatibility with United States and foreign flag vessels operating in the Great Lakes.

A point of issue at present is the need for controls over the release of so-called 'grey water' - waste water originating from galley sinks and crew or passenger washing facilities. To date, there has been no conclusive evidence to suggest that such discharges pose a health or ecological threat. A study recently completed by the Ontario Ministry of the Environment may shed further light on any need for grey water controls once its contents have been made publicly available.

Except for the larger ports in Ontario, commercial shipping is not particularly well served by reception facilities for sewage and garbage. Offsetting these deficiencies is the fact that the larger commercial vessels are invariably fitted with MSDs which process sewage generated on board. Foreign vessels, some of which may be equipped with sewage holding tanks, take advantage of pump-out facilities at Montreal to offload accumulated sewage from their holding tanks. Ships in transit also take advantage of garbage disposal facilities at Welland to dispose of garbage wastes. Moreover, some vessels choose to incinerate their own garbage wastes, thus avoiding any difficulties with waste disposal facilities at ports. Pleasure craft seldom have trouble pumping out sewage holding tanks or disposing of garbage, since most marinas offer these services.

ANNEX 6:
Review of Pollution From Shipping Sources

Annex 6 of the Agreement requires that both the Canadian and United States Coast Guards review aspects of shipping on the Lakes having an environmental impact, to ensure that appropriate protective measures are in place and are being maintained. To this end, joint meetings are held annually, between the two Coast Guards, to consider Annexes 4,5,6,8 and 9 of the Agreement. A report of each year's joint meeting is prepared and submitted to the International Joint Commission.

Generally, the construction, equipment, staffing and certification requirements applicable to Great Lakes shipping are adapted from those applied by the various Conventions of the International Maritime Organization to sea-going ships, although there are many significant differences. For example, ships certified for exclusively inland waters service can be constructed to lighter scantlings than sea-going ships, since wave bending stresses on the ships' hulls are considerably less than those experienced by sea- going ships. On the other hand, the more demanding nature of navigating a ship in the narrow confines of the St. Lawrence Seaway and other canal systems requires that the ship be under the control of a qualified pilot. These two examples are merely indicative of the types of differences to be found between sea and lake service.

On February 24, 1989, Canada became a party to the 1969 Civil Liability Convention and the 1971 Pollution Fund Convention. In the event of a spill of oil in the Lakes, from a sea-going tanker, the International Fund would cover approximately $100 million of third party liability claims arising from oil spill damage to Canadian territory. An additional $100 million of coverage is available from the Ship Source Oil Pollution Fund, instituted under Part XVI of the Canada Shipping Act.

Of major concern during the biennial period since the last report of the Parties, has been the discovery of several new non-native species of aquatic organisms in the waters of the Great Lakes. A study, commissioned in 1989 by Environment Canada, had indicated that foreign organisms were present and alive in the ballast water of vessels visiting Great Lakes' ports. In reviewing the study at the 1981 joint meeting between the United States and Canadian Coast Guards, it was concluded that there appeared to be no identifiable public health problem attributed to ballast water discharges at that time. It was further concluded that the potential for ecological impact from the introduction of foreign flora and fauna via ballast water discharges was unknown, given that ballast water discharges had been occurring for many decades. The study was referred to the Water Quality Board of the International Joint Commission to determine the significance of random introductions of foreign organisms in ballast water on the Great Lakes ecosystem as a whole.

During the July, 1988, Joint Coast Guards' meeting, a presentation by a representative of the Great Lakes Fishery Commission reported the discovery, in the Lakes, of three non-indigenous species, namely: the European river ruff *(Gymnocephalus cernus);* the spiny water flea *(Bythotrophes cederstroemi);* and the zebra mussel *(Dreissena polymorpha).* Following this presentation, the Canadian Coast Guard, in collaboration with the Department of Fisheries and Oceans, the Great Lakes Fishery Commission, Environment Canada, the United States Coast Guard and representatives of foreign and domestic shipping companies, developed a set of ballast water exchange guidelines for introduction at the opening of the 1989 Great Lakes shipping season. In September, 1988, the International Maritime Organization was informed of the ballast water problem by the Canadian delegation to the Marine Environment Protection Committee (MEPC), with a request for member state and shipping industry compliance with Canada's ballast water control guidelines.

Based upon a 20 per cent sampling of ships in transit through the St. Lawrence Seaway, overall compliance with the guidelines in 1989 was approximately 83%. An improved version of the Guidelines has been reintroduced for the 1990 shipping season and a current compliance rate of approximately 97% is reported.

Recognizing that the use of ballast water is essential to safe operation of ships and being aware of the international nature of the problem, the Canadian delegation to the March, 1990, meeting of MEPC successfully argued that the issue be included on the work program of the Committee. Consequently, at the 30th session of MEPC in November, 1990, and with a provision for continuation at two subsequent sessions, a working group was established to seek an international solution to the ballast water problem.

In May, 1990, the Department of Fisheries and Oceans, Environment Canada and the Canadian Coast Guard jointly funded a Great Lakes ballast water study. The study monitors ship compliance with the ballast water exchange guidelines and tests the effectiveness of open ocean water exchange in reducing the accidental introduction of foreign organisms. It is anticipated that results from this study will be available by mid-1991.

This work was initiated from recommendations resulting from a ballast water workshop co-convened by the International Joint Commission and the Great Lakes Fishery Commission.

The International Joint Commission and the Great Lakes Fishery Commission released a report in September, 1990, titled, *Exotic Species and the Shipping Industry: The Great Lakes-St. Lawrence Ecosystem at Risk.* Official responses to the recommendations from this report are tabulated (in Appendix One) following the responses to the recommendations from the *Fourth and Fifth Biennial Reports* of the IJC.

Some criticism has been raised with respect to the decision to apply voluntary ballast water control guidelines in lieu of mandatory regulations. There are several valid reasons for this choice. Contrary to popular belief, the existence of regulations does not ensure compliance with them. Without effective means of enforcement, regulations may be counter-productive by encouraging ships to conceal or evade compliance to avoid prosecution. Evasion is particularly relevant when forced compliance with an ill-founded regulation may well place a ship and its crew at risk. Moreover, were a ship to be lost while complying with a regulatory requirement, legal action against the Crown may justifiably well ensue. It should also be noted that there is, as yet, no conclusive proof that the ballast water exchange procedure is fully effective in destroying unwanted organisms present in ballast water, and considerable evidence to indicate that the sediment in ballast tanks that have been exchanged could continue to harbour the cysts of unwanted organisms. Pending an assessment of the effectiveness of the ballast water exchange procedure, regulations would appear to be premature. Faced with a similar problem, involving the presence of dinoflagellate spores in the ballast water of visiting Japanese ships, the Australian Administration in 1989 introduced regulations, under their quarantine laws, to control ballast water discharges. These were withdrawn several weeks later in favour of voluntary guidelines. Nor should failure to achieve 100 per cent compliance with the Guidelines be viewed as indicative of their failure. There are several alternate media by which non-native species may enter the Great Lakes, although ballast water discharges are the most probable. A reduction, by almost two orders of magnitude, in the probability that ships will discharge non-exchanged ballast water in the Lakes should not be dismissed lightly.

Since the opening of the 1990 shipping season on the Lakes, a compliance and effectiveness monitoring program has been under way at the St. Lambert Lock in Montreal. This program, administered under contract by the University of Toronto, samples ships' ballast water for salinity and subsequent testing to identify organisms that may be present. The results of the sampling program, which will continue until the closure of the 1990 St. Lawrence Seaway season, should indicate whether ballast water exchange is an effective method for preventing the introduction of unwanted organisms and if reported compliance with deep sea exchange is borne out by high ballast water salinity readings.

In conjunction with many other concerned authorities, the Canadian Coast Guard will continue to administer ballast water controls and to support necessary research, both nationally and internationally, aimed at establishing a long term strategy to effectively minimize the risks associated with ballast water discharges in the Great Lakes and elsewhere.

Zebra Mussels

The zebra mussel, a one to five centimetre freshwater mussel native to Europe, gained access to the Great Lakes in the ballast water of trans-Atlantic ships. They were first reported in Lake St. Clair in 1986. By 1989 they had colonized all of the available shallow water habitat in Lake St. Clair and western Lake Erie. They have now been found in isolated pockets in all of the Great Lakes.

Distribution has been facilitated by the high reproductive capacity of the mussel and the large amount of inter-lake shipping. Mussels spawn at two years of age, releasing 30,000-40,000 eggs per female. The eggs hatch in two to three days into free swimming larvae that may be transported hundreds of kilometres by lake currents. By the end of the first year, the mussel has developed strong byssal threads which attach firmly to rocks and other hard surfaces including metal, plastic, rubber and wood. Mussels can accumulate several layers deep on rocky reefs, navigation buoys, gas wells and water intake pipes. Populations as high as 700,000 per square metre have been reported in western Lake Erie. Although fish and diving ducks are now feeding on mussels in Lake Erie, there is no indication that populations have stabilized or started to decline.

Despite the fact that mussels are present in isolated areas in all of the Lakes, low calcium concentrations and cooler temperatures of the Upper Lakes will probably limit distribution and growth. In an effort to prevent access to the inland lakes, the Government of Ontario has instructed boat owners and fishermen to remove mussels from boats and bait containers. However, young mussels are almost invisible to the naked eye and it is probable that mussels will spread to all shallow, warm and eutrophic lakes including the Muskoka and Kawartha Lakes. Since mussels require high calcium levels in order to flourish, they are not expected to become a major problem in the soft water lakes of the Canadian Shield, which are low in calcium.

In western Lake Erie, large populations of zebra mussels have colonized municipal and industrial water intake pipes resulting in flow reduction, putrefaction, methane production, and corrosion of steel and cast pipes. It is estimated that the economic impact will exceed hundreds of millions of dollars. The most common method of control involves the periodic treatment of intakes with chlorine to kill larvae and adults.

The ecological impacts of zebra mussels are still being determined. On the positive side, there may be a significant increase in nearshore water clarity due to the enormous volume of water that is filtered by the entire mussel population. On the other hand, mussels sometimes build up on crayfish and clams, impeding their mobility and eventually killing them. Heavy infestations of mussels have covered the spawning shoals of shallow water fish in Lake Erie, altering their physical and biological characteristics and threatening important commercial species such as walleye. Similar problems could occur on the spawning shoals of Lake Ontario whitefish and lake trout. In addition, waterfowl are feeding on the mussel and remaining in the Point Pelee area in large numbers. This has led to a change in waterfowl migration patterns, which may be expected to occur in other areas of the Great Lakes.

The implementation of programs to reduce the damage caused by zebra mussels will require co-operative binational programs. Federal and provincial representatives met with U.S. colleagues in Washington in October, 1990, to discuss the problem. It was agreed that there are several areas where co-operation and joint initiatives on zebra mussels were warranted, including:

- convening a binational workshop of researchers to review findings and progress;
- sharing of European (translated) literature;
- cataloguing of research projects; and
- developing joint studies where needed.

Under consideration is the establishment of a bilateral co-ordinating committee to oversee and develop the above activities.

Zebra mussels are here to stay and are now part of the Great Lakes Ecosystem. The impact of zebra mussels will vary greatly in the different conditions of the Lakes, but it appears that elimination of the pest is not possible and we can only hope to limit its damage. Further insight into the life requirements of the zebra mussel is necessary in order to understand how to deal with the problem.

ANNEX 7:
Dredging

Dredging activities under the Agreement are primarily the responsibility of the IJC's Great Lakes Water Quality Board. While there are no specific reporting requirements by the Parties under Annex 7, there has been activity since the December, 1988 *First Report of Canada*. (The COA Pòlluted Sediment Committee is responsible for ensuring that Canada's commitments under Annexes 7 and 14 of the Great Lakes Water Quality Agreement, as revised by the Protocol of 1987, are met.)

(i) Review Dredging Practices

- Existing dredge spoil disposal criteria (Ontario Ministry of the Environment, U.S. EPA) and IJC procedures for the evaluation of dredging projects have been reviewed.
- Current dredging procedures and techniques in Quebec and Ontario have been evaluated.
- By agreement with United States agencies, (U.S. EPA & U.S. COE) information and developments respecting technology continue to be exchanged, with the expectation this will lead to the development of compatible criteria for dredging activities.
- The Dredging Register continues to be updated. The 1980-1984 Register was released by Canada and the United States in September, 1990, and the 1985-1989 Register is scheduled for release during summer 1991.

(ii) Specific Criteria for the Classification of Polluted Sediment

- Draft Sediment Quality Guidelines have been prepared by Ontario and are being reviewed.
- Biological sediment guidelines are being developed by Environment Canada in consultation with Ontario Ministry of Environment.
- Exchange of information between the Canada Ontario Polluted Sediments Committee and the United States Environmental Protection Agency's Assessment and Remediation of Contaminated Sediments Committee is proceeding.
- Pollution from Contaminated Sediment is addressed under Annex 14.

(iii) Dredging and Wetlands

- The preservation of Wetlands is considered in relation to pollution from dredging activities under Annex 13.

(iv) Encouragement of Research

- Meetings and workshops continue to occur where information and development relating to dredging technology and environmental research are exchanged. A joint Canada/U.S. workshop on Bioremediation Technologies was held in Manitowoc, Wisconsin. The focus of the session was to identify technologies applicable to polluted sediments in Areas of Concerns.

ANNEX 8:
Discharges from Onshore and Offshore Facilities

Annex 8 requires that regulations be adopted for the prevention of discharges of oil and hazardous polluting substances. The Canadian Coast Guard's involvement, with respect to onshore and offshore facilities, is limited to those provisions of regulations relating to adequate lighting intensity at the loading and unloading manifolds of shore terminals, arrangements to ensure the provision of suitable communications during oil transfers, and to the requirement that a competent person be in charge of oil transfer operations for the terminal.

Where oil or a chemical pollutant enters Great Lakes waters as the result of a spill from an onshore or offshore terminal, the Coast Guard will provide emergency response services. No spills requiring Coast Guard involvement were reported from onshore or offshore facilities during the two year period covered by this review.

During 1990, Environment Canada initiated the Regional Spills Measurement and Reporting Pilot Project in Ontario to demonstrate and encourage the use of an integrated spill reporting system for the major Canadian spill reporting agencies in the Great Lakes.

Funding for the project was obtained through the Great Lakes Action Plan, and by late 1990, equipment and customised reporting software were established and functioning within the Canadian Coast Guard Traffic Centre, the Ontario Ministry of the Environment Spills Action Centre and the Environmental Emergency Division of Environment Canada. The inter-agency communication links were tested and are in the process of being refined and should be fully operational by March, 1991. When the project is completed and fully evaluated by all parties, formal spill reporting agreements will be developed to enhance alerting, notification and response procedures for spills in the Great Lakes.

If further funding is available, additional development work is planned to compile and analyze the spill data from the Canadian Coast Guard, the Ontario Ministry of the Environment and Environment Canada to produce annual Spill Trend Reports to determine the actual loading from spills into the Great Lakes.

Additional development work is planned, subject to further funding, on common electronic sensitivity mapping systems and slick trajectory modelling data bases to assist federal and provincial spill response personnel, and electronically link them to the Environment Canada emergency response network.

ANNEX 9:
Joint Contingency Plan

The Canada-United States Joint Marine Contingency Plan makes provision for a co-ordinated and integrated response to pollution incidents occurring in contiguous waters of Canada and the United States. Annex One to the Joint Contingency Plan applies specifically to the waters of the Great Lakes and is known by the acronym CANUSLAK. The CANUSLAK plan may be invoked by either party in the event of a significant spill occurring, if assistance from the other party is requested.

During the biennial period covered by this review, there were, thankfully, no occasions when the CANUSLAK plan had to be invoked. Nevertheless, it is the policy of the two Coast Guards to exercise the Joint Contingency Plan every two years.

On February 3-5, 1988, a major CANUSLAK exercise was held at St. Catharines, Ontario. Approximately 120 people, representing a cross-section of interested government and private sector agencies, participated in the exercise.

On September 10-12, 1990, another major CANUSLAK exercise was held in Port Huron, Michigan, to test the Joint Response Plan. During the simulated oil spill on the St. Clair River, various federal, state, provincial and local municipal and industry representatives tested their spill contingency plans.

The Joint Response Team spent approximately eight months planning, developing and preparing for the exercise. An exercise evaluation is currently under way and the evaluation report should be available by March, 1991.

The Province of Ontario's Spill Contingency Plan provides a mechanism to deal with major spills under provincial jurisdiction which threaten the environment and to assist the Canadian Coast Guard when requested. The Ontario Ministry of the Environment's primary role in spill incidents is that of a regulatory agency enforcing the duties and provisions imposed by the Ontario Environmental Protection Act. When notified of a spill, the Ministry will assist in warning "downstream" users or potentially affected parties and other agencies where applicable. The Ontario Ministry of the Environment also developed a preventative strategy which requires targeted industries to implement spill reduction programs by February 1, 1992.

The 1989 grounding of the tanker Exxon Valdez in Alaska, and the subsequent disastrous oil spill, alerted Canadians to the dire consequences of a major tanker accident within the Great Lakes. While vessels using the Great Lakes are restricted in size to a fraction of that of the Exxon Valdez, the enclosed fresh water nature of the Lakes and their use by many millions of citizens would make any large tanker oil spill a very serious event. Recognizing that fact, a Public Review Panel on Tanker Safety and Marine Spills Response Capability was struck and hearings were held across Canada. In November, 1990, the Public Review Panel released its report, *Protecting Our Waters*. The federal government has established an implementation team to review the recommendations of this report and to decide on an appropriate course of action.

ANNEX 10:
Hazardous Polluting Substances

The Annex was intended to be used as a registry for substances known to have toxic effects on aquatic and animal life, and having the potential of being discharged into the Great Lakes. The registry has two lists. The first list contains names of substances deemed to be "hazardous polluting substances", and the second list contains the names of "potential hazardous polluting substances" which are candidates for list one.

The Canadian Coast Guard maintains the lists but there have been no revisions for several years and the Canadian Coast Guard and Environment Canada plan no specific work to amend or add further substances to the lists.

This Annex does not provide controls or prohibitions for the designated "hazardous polluting substances", whereas the Transportation of Dangerous Goods Act, the Canada Shipping Act, and Ontario provincial legislation do enable restrictions on the transport of identified substances. Internationally, the intent of Annex 10 has been met by the International Maritime Organization Convention and specific U.S. hazardous polluting substances legislation. These efforts have led to the development of new lists of hazardous polluting substances which are continually being updated.

In 1989, Environment Canada initiated a review of existing Transport of Dangerous Goods Act and Shipping Act controls respecting hazardous materials, and conducted a preliminary evaluation of the practical value of Annex 10 in light of these and other alternative control mechanisms. The review was subsequently deferred and the resources were redirected to the priority concerns expressed by the International Joint Commission regarding the need for a common spill reporting system among major spill response agencies on the Great Lakes. This concern was also identified in the federal government's "Green Plan" and the September, 1990, Report of the Public Review Panel on Tanker Safety and Marine Spills Response Capability, titled *Protecting Our Waters*.

Environment Canada will work in co-operation with the Canadian Coast Guard to review the value of the Annex's list, in the context of other national and international legislation, shipping and product controls. Subsequent efforts in support of Annex 10 will be a function of this review and its recommendations.

ANNEX 11:
Surveillance And Monitoring

Federal Activities

Human Health Aspects

Health and Welfare Canada, under the Great Lakes Health Effects Program, is developing a strategy for surveillance of contaminant levels in human tissue and fluids. Few data currently exist on contaminant levels in humans. Such data are essential in estimating the extent and magnitude of the risk associated with exposure to environmental contaminants, and in assessing temporal and geographical trends. As well, it will assist in the identification of human populations most at risk. In conjunction with this project, plans are being developed for the creation of a human tissue bank which would be used for archival storage of human tissue samples for future analysis. Similar to the tissue bank at the Canadian Wildlife Service, such a facility would offer the ability to retrospectively assess historical samples as better technology is developed for detection and quantification of contaminants.

Two studies are currently examining levels of environmental contaminants in human tissue. One project is determining the levels of toxaphene, co-planar PCBs, chloronaphthalenes and chlorodiphenyl ethers in human adipose from the Great Lakes Basin. Another project is assessing regional differences within the Great Lakes Basin in the levels of organohalogen contaminants in human follicular fluid samples. Earlier work has revealed the presence of contaminants in follicular fluid samples from people residing in Hamilton, Halifax and Vancouver. The present study is also expanding to include isomer-specific PCB analyses and analysis of the most toxic dioxin, TCDD (chemical name: 2,3,7,8-TCDD) and a polychlorinated dibenzofuran, TCDF (chemical name: 2,3,7,8-TCDF).

Research on herring gull eggs from Lake Ontario and on fish and human samples from Japan showed that known organochlorine compounds constituted only a fraction of the total organohalogens present in the tissues. Researchers from the Foods Directorate are examining the total organohalogen content of Great Lakes fish using neutron activation and comparing it against the amounts of known organochlorines and organobromines identified using current methodologies. This will establish the contribution of known contaminants to the overall burden of organohalogens.

Open Lakes Surveillance

One full-chemistry spring and one limited-chemistry summer surveillance cruise were conducted in 1988 on each of Lakes Superior, Huron/Georgian Bay and Ontario from the Canadian research vessel CSS Limnos by the Water Quality Branch of the Inland Waters Directorate. The same schedule was planned for 1989, however, due to early decommissioning of the ship, the summer cruise on Lake Superior was cancelled. Water samples were submitted to the National Water Quality Laboratory in Burlington for analysis, which included nutrients, major ions, and, in 1988, trace organic contaminants. Information from these activities is presented biannually to the Great Lakes Water Quality Board of the IJC for inclusion in their report to the Commission.

Spring surface (1 m) mean total phosphorus concentrations for Lake Superior (1983-89) and Lake Huron (1980-89) did not show any significant ($p<0.05$) trend; 1989 mean spring concentrations were 2.9 and 4.4 $\mu g/L$ of phosphorus, respectively. While long term (1968-89) Lake Ontario total phosphorus concentrations indicate a significant ($p<0.05$) decreasing trend of 0.9 $\mu g/L$ per year, concentrations since 1985 have shown no significant change, oscillating at approximately 10 $\mu g/L$, the acceptable in-lake concentration as recommended by the Phosphorus Management Strategies Task Force (1980) *[Figure 1]*. The long term increasing nitrate-plus-nitrite trends which have consistently been reported in each of the Great Lakes, have shown deviations in recent data. In Lake Superior, spring surface (1 m) filtered nitrate-plus-nitrite concentrations declined from a high of 344.6 $\mu gN/L$ in 1985 to 326.7 $\mu gN/L$ in 1987; 1989 concentrations, however, have recovered to levels near those observed in 1985. Lakes Huron and Ontario have shown similar declines in 1988 and 1989 *[Figure 2]*, when, previously, annual increases were 6.8 (1971-87) and 9.6 $\mu gN/L$ per year (1968-87), respectively.

FIGURE 1

LAKE ONTARIO
Total Phosphorus

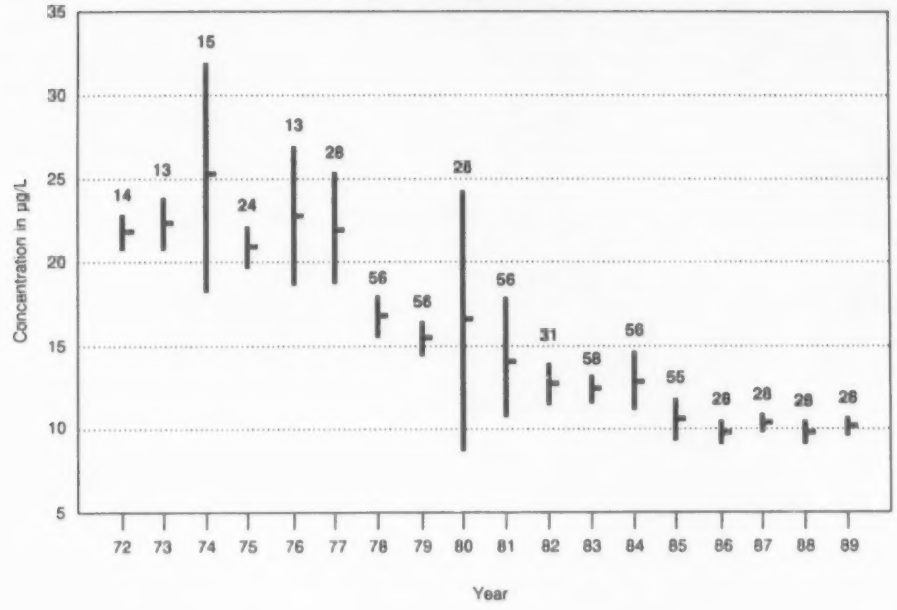
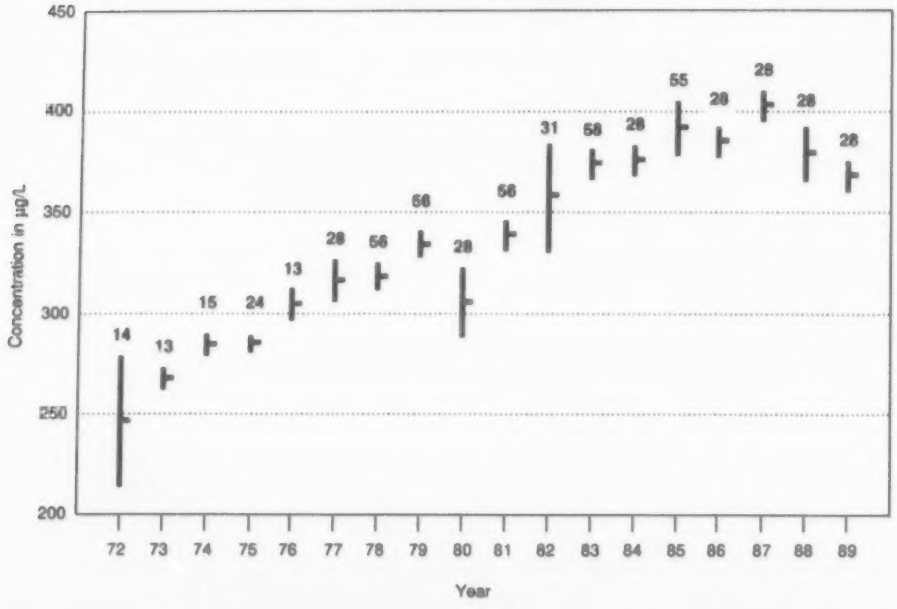


FIGURE 2

LAKE ONTARIO
Nitrate/Nitrite - Filtered



Atmospheric Loading

Inland Waters Directorate, Ontario Region continued to operate a network of 16 precipitation stations in support of the IJC Great Lakes International Surveillance Plan to estimate atmospheric loadings of nutrients, major ions and trace metals to the Great Lakes. The organic precipitation network was expanded to six stations in 1989: Thunder Bay, South Baymouth, Walpole Island, Pelee Island, Wolfe Island and Point Petre. A report summarizing the organic precipitation data collected to date is being prepared. Preliminary analysis of the data shows seasonal variability and north-south differences for many of the contaminants.

Surveillance Related Research

National Water Research Institute support for surveillance and monitoring activities, under Annex 11, has included the development, procurement and testing of state-of-the-art water quality profiling systems. These activities are designed to increase the efficiency of the surveillance program, while at the same time improve the precision and accuracy of the data gathered. Great Lakes Action Plan (GLAP) funding has provided some of the necessary resources to begin modernization of the basic field monitoring capability of the various agencies undertaking Great Lakes Water Quality Agreement surveillance, monitoring and research. In particular, there were two initiatives: (i) an Acoustic Doppler Profiling System was to be acquired and made operationally available to researchers, and (ii) the major research vessels are being equipped with state-of-the-art Water Quality Profiling Systems over a three year period. The former involved the purchase of commercial equipment and implementation for particular research needs while the latter involves system definition, component specification, procurement, acceptance testing and implementation.

The prototype of the Water Quality Profiling System is currently undergoing testing against specification. This will be completed by mid-September, 1990. Field tests are planned for the fiscal year 90/91 late fall period in Hamilton Harbour, with the prototype unit in service aboard the CSS Limnos for the FY 90/91 field season. A second system will be procured upon completion of the present acceptance tests.

The Acoustic Doppler Profiler (ADP) and controller was delivered in March, 1990, and operation and maintenance crews were sent on training courses. An initial successful deployment was undertaken in Hamilton Harbour, with data taken to support the RAP program. The system was subsequently deployed in the Burlington Ship Canal where it is currently acquiring a time-series data set. Further, the MV Gander is being modified in the NWRI Machine Shop to enable mounting of the ADP for a real-time data gathering along the north shore of Lake Ontario. By the start of the 91/92 field season, this device will be completely operational.

In addition, the Institute, through the Quality Assurance Group, Research and Applications Branch, has designed, developed and implemented external quality assurance studies. These studies are evaluated through the IJC Great Lakes Regional Office by the Data Quality Work Group and address the performance of laboratories in the United States and Canada. Comparison studies have involved over 100 laboratories. Studies over the last two years have included phosphorus in waters (low level), phosphorus in sewage effluents, toxic metals in sediments, and toxic organics (e.g., PCBs, OCs, and PAHs) in sediments in ampoule standards.

These studies provide a measure of laboratory performance and, in part, evaluate the comparability and compatibility of the many data sets used in assessing the state-of-the-Lakes under the Great Lakes International Surveillance Plan.

Improvements were made on the statistical analysis of river monitoring data, specifically better precision and separation of the effects of analytical method changes and station variability as well as trend analysis. The methodology is superior to previous ones. It uses several factors, the most important of which is the consideration of seasonal components. Additional work on the statistical analysis of Niagara River contaminant data is ongoing. The previously common procedure of replacing non-detectable values with those between zero and the detection limit, was shown to produce biased means and standard deviations. Our research now allows the calculation of such biases, and hence improves the accuracy of data interpretation.

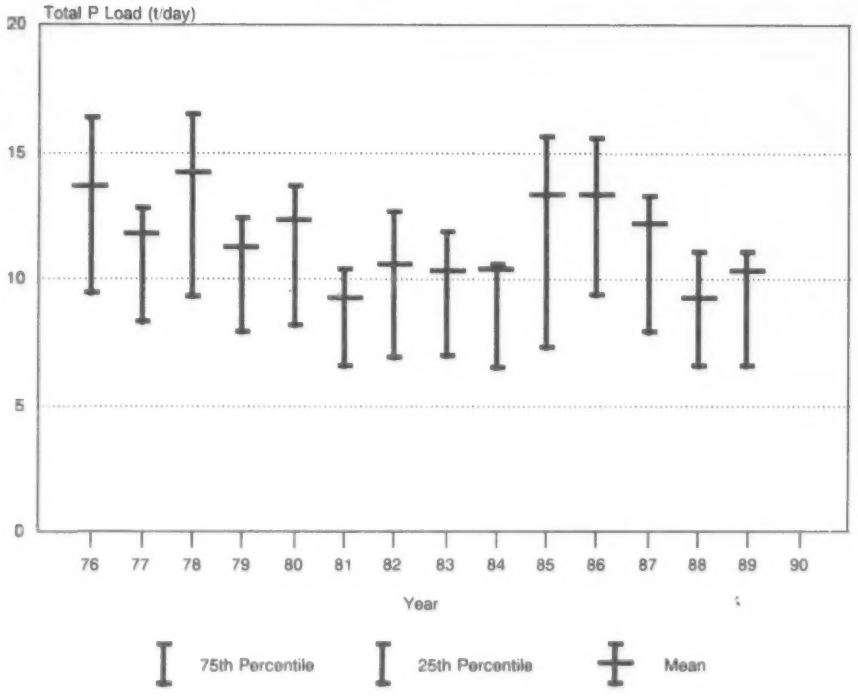
Inter-Connecting Channels Water Quality

NIAGARA RIVER: May, 1990, marked the 15th anniversary of collecting water quality samples at the Niagara-on-the-Lake station by the Inland Waters Directorate, Ontario Region. Data from this station are used to calculate loadings into Lake Ontario. In 1983, a station was established at Fort Erie for the purpose of determining exit loadings from Lake Erie. Automatic water quality samplers at the two sites collect samples three times a week for nutrients, with weekly samples being collected for trace metals, major ions and trace organic contaminants. Results of these analyses are provided biannually to the IJC for inclusion in the Water Quality Board's report to the Commission.

Similar to the total phosphorus trends observed in Lake Ontario, Niagara River total phosphorus concentrations and loads demonstrated a significant decrease during the 1977-1984 period, but have stabilized since

FIGURE 3

Total Phosphorus Load (t/day) at Niagara-on-the-Lake



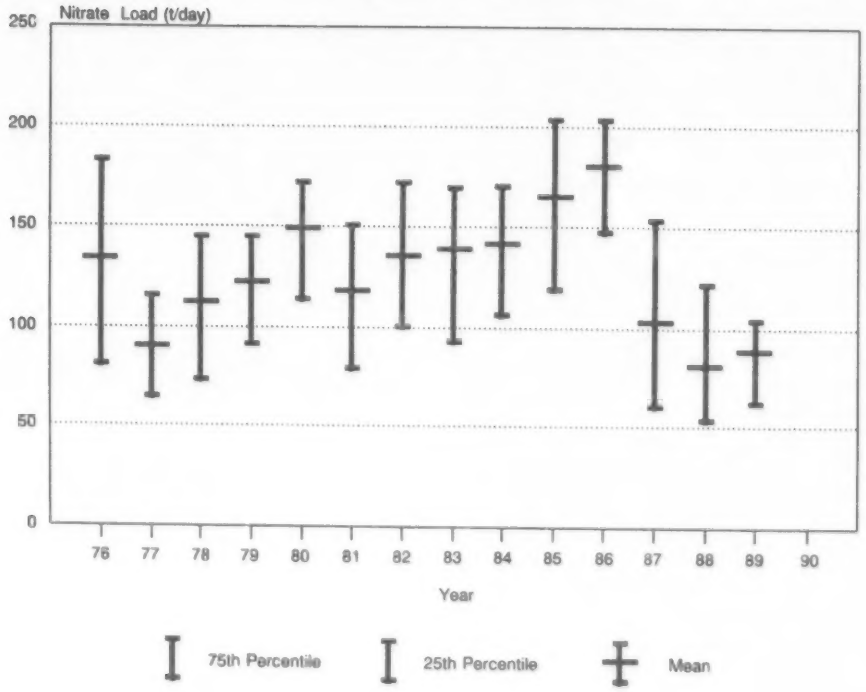
1985 (Kuntz and Tsanis, 1990) *[Figure 3]*. Casey and Salbach (1974) determined that the Niagara River accounts for about 50 per cent of the nitrogen inputs to Lake Ontario. Williams et al. (in press) reported that Niagara River nitrate-plus-nitrite concentrations showed a continuous, significant increase of 4 gN/L.yr during 1976-87, except in 1987, when concentrations decreased; loadings to Lake Ontario also decreased in 1987 *[Figure 4]*. A smaller decrease in loadings, relative to 1987, was observed in 1988. Combined, the decrease in loads for these two years accounts for approximately 58 per cent of the change in in-lake mass for Lake Ontario.

ST. LAWRENCE RIVER: Water quality monitoring by Inland Waters Directorate, Ontario Region continued in the St. Lawrence River at the Wolfe Island station. The database for this station now spans more than a decade. The objective of this program is to provide chemical exit loadings from Lake Ontario to the River. Twice-weekly water samples are collected for nutrients and weekly samples are taken for trace metals. On a monthly basis, large-volume water samples and suspended sediment samples are collected for organic contaminant analysis. The report *Loadings of Selected Chemicals into the St. Lawrence River System from Lake Ontario, 1986/87* was published in the Water Pollution Research Journal of Canada. Data from this program are also included in the Water Quality Board's Biennial Report.

Water quality at the end of the international section of the St. Lawrence is impaired by industrial centres on both sides of the River. This is the third year Inland Waters Directorate, Ontario Region has been monitoring in the Cornwall/Massena reach of the St. Lawrence River. The objective of the program is to develop strategies to estimate transboundary movement of contaminants, particularly PCBs. In each of the three years, samples were collected for trace organic contaminants, trace metals, nutrients and major ions. Preliminary data indicated transboundary movement of PCBs from the Massena reach of the River to both Ontario and Quebec. Thus, PCB congener profiles were added in 1989 in an attempt to trace new inputs of PCBs within this reach of the River and to identify transport pathways. The final survey, in 1990, included the collection of freshwater biota (mussels), suspended particulate and bottom sediments. These data, combined with ex-

FIGURE 4

Nitrate-Nitrite Nitrogen Load (t/day) at Niagara-on-the-Lake



tensive hydraulic measurements, will be used to develop a contaminants dispersion model which will support design of a long term monitoring program for this reach of the River.

Environmental monitoring studies done by the Great Lakes Laboratory for Fisheries and Aquatic Sciences have focused on the effects of pulp and paper mill effluents, aquatic organisms, and their habitat. Biochemical methods are being refined or developed to effect cause-and-effect relationships between chemical exposure and chronic effects. Reproductive impairments have also been observed in fish containing elevated concentrations of chlorinated organic chemicals, although the specific causes have not been identified. Various techniques are being examined to provide a more comprehensive assessment of the chronic effects of chemicals in fish health. Other studies are investigating methods to assess physical and chemical effects on the biological integrity of aquatic ecosystems. The impact of accidental introductions of undesirable organisms like the zebra mussel is also being examined. A major initiative has also been made in examining the problem of environmental degradation using the ecosystem health concept.

Canada-United States Binational Activities

Integrated Atmospheric Deposition Network

Environment Canada's Inland Waters Directorate, Ontario Region also participated in the COA Airborne Toxics Committee, which is involved in formulation of the implementation plan for the Canada/U.S. Integrated Atmospheric Deposition Network called for under Annex 15 of the revised Protocol to the GLWQA. The First Canadian master station has been established in Point Petre (See **Annex 15**).

Niagara River Toxics Management Plan

In February, 1987, the Governments of Canada, Ontario, the United States and New York signed a Declaration of Intent to reduce point and non-point source loadings of persistent toxic substances to the Niagara River by 50 per cent by 1996. Work would be jointly undertaken in the context of the Niagara River

Toxics Management Plan. Under the Plan, water and suspended sediment samples collected at Niagara-on-the-Lake and Fort Erie were analyzed for a variety of metals and organics (including volatiles, chlorophenols, organochlorine pesticides and PCBs, polynuclear aromatic hydrocarbons, 2,3,7,8-TCDD, phthalates and chlorobenzenes). Analyses of the samples provided data to estimate the loadings of these chemicals to the river and to Lake Ontario. A joint four-party report, on the first data set collected from April, 1986 to March, 1987, was released in January, 1988. A summary and interpretation of Niagara River ambient water quality data for the period April, 1987 to March, 1988 was released in May, 1989. The report on April, 1988 to March, 1989 data was released in December, 1990.

The Categorization Committee was formed in December, 1988, under the umbrella of the Lake Ontario and Niagara River Toxics Management Plans. The Committee was thus comprised of representatives form each of the four parties. The Niagara River Toxics Management Plan (1988 Revision) included a preliminary categorization of 92 toxic chemicals present or potentially present in the Niagara River. These chemicals were categorized based on their ambient concentrations (in water and fish) relative to existing standards and criteria. As a first priority, the Categorization Committee was charged to review this preliminary scheme and update/revise as required. The final categorization would then provide a basis for determining appropriate river-wide management actions that would contribute to the reduction of priority chemicals within the Niagara River. The Committee's final report was submitted to the Niagara River Secretariat in June, 1990.

An extensive Upstream/Downstream River Monitoring Program has been developed using sampling and analytical protocols agreed to by the Four Parties. The program has been operated by Environment Canada since 1986-1987. Agency monitoring programs provide data for point source and non-point source discharges to the Niagara River but do not utilise agreed upon sampling and analytical protocols.

An ad hoc working group has been formed under the NRTMP to prepare the first Niagara River 50 Per Cent Reduction Progress Report. Using the three years of data (1986-87, 1987-88, 1988-89) collected since the signing of the Declaration, the progress report will serve as an important report card on our ability to date to reduce loadings to the Niagara River, to effectively measure changes in point and non-point source inputs, permitting accurate assessment of our progress in achieving the 50 per cent reduction target.

Provincial Activities

During the last two years, provincial surveillance and monitoring activities have been largely oriented around the Remedial Action Plan (RAP) Program. In addition, the Province conducts short term studies to assess the response to specific controls, as well as to identify emerging problems. Longer term activities are conducted to evaluate water quality trends.

Information based on these activities is presented in Ontario Ministry of the Environment reports, in scientific papers, and at technical conferences (Appendix 3). Pertinent results from these studies are also summarized in Remedial Action Plan Stage I and II reports, Remedial Action Plan technical reports and options discussion documents, and are submitted to the Water Quality Board for inclusion in the Board's Report to the International Joint Commission.

The Province has also provided support to the IJC through membership on the Water Quality Board, Water Quality Programs Committee, Restoration Subcommittee, Surveillance Work Group and associated Task Forces.

The Remedial Action Plan Program

In support of the development of Remedial Action Plans, the Province has conducted a number of field studies to update knowledge of environmental conditions, and to identify associated impaired uses and pollution sources for the completion of Stage I reports for the 17 Canadian Areas of Concern. Assessments, such as sediment and benthic surveys and sediment bioassays, are conducted to provide necessary information on biological impacts before recommendations for remedial measures can be made. Other sampling programs are carried out in order to develop appropriate remedial options and surveillance plans for implementation and to track the effectiveness of remedial measures. The following surveillance activities were carried out by the Province during 1989 and 1990 in support of the RAP program:

- Nipigon Bay Sediment Survey
- Jackfish Bay Environmental Survey
- Peninsula Harbour Sediment and Bioavailability Study
- Algoma Slip Sediment Contamination Assessment
- Spanish River/Spanish Harbour Suspended Sediment Source Characterization
- St. Clair River Sediment and Benthic Community Assessment
- Severn Sound Marina Survey
- Severn Sound Sediment Bioassessment

- Collingwood Harbour Water Quality Survey-Collingwood Harbour Mussel Biomonitoring Study
- Collingwood Harbour Sediment Cores and Bioassessment
- Niagara River Caged Mussels and Leeches
- Hamilton Harbour Sediment Mass Balance Study
- Hamilton Harbour Sediment Load Bioassessment
- Hamilton Harbour Bacteria Survey
- Toronto Waterfront Dry Weather Outfall Study
- Toronto Waterfront Wet Weather Outfall Study
- Assessment of Tributary and STP Loadings to the Metro Toronto Waterfront
- Port Hope Sediment Bioassessment Study
- Bay of Quinte Toxic Contaminants Study
- St. Lawrence River Bacteriological Conditions
- Cornwall Sediment Remediation Study
- Sediment Metals Bioavailability Study at Areas of Concern.

The Investigations Program

Each year the Province conducts studies throughout the Great Lakes nearshore to report on environmental conditions, assess compliance, identify emerging problems or to define baseline conditions. Baseline conditions need to be established for monitoring changes in water, sediment and biota quality associated with anticipated future developments in some areas. Data are also required to monitor localized impacts from land-based activities and to recommend abatement. Follow-up investigations are often warranted to assess response to specific controls. The following investigative activities were carried out by the Province during 1989 and 1990:

- Lake Superior/North Channel Embayment Biomonitoring
- Thunder Bay Outer and Northern Harbour Baseline Study
- Fate and Effects of Organochlorines from Kraft Mill Discharges
- Algoma Slag Dump Sediment Assessment
- Sault Ste. Marie Wastewater Treatment Plant Evaluation
- Georgian Bay Eutrophication Monitoring
- Parry Sound Environmental Survey
- Talfourd Creek Investigation
- Detroit River Environmental Investigation
- Huron Valley Water Pollution Control Plant Outfall Premonitoring Program
- Lake Erie Synoptic Survey
- Toronto Waterfront Sediment Survey
- Cataraqui Bay Survey.

The Surveillance Program

In addition to site-specific studies, the Province conducts basinwide monitoring and surveillance programs in support of the Great Lakes Water Quality Agreement. For example, in 1989 and 1990 a number of long term surveillance projects were maintained by the Ontario Ministry of the Environment to monitor nutrients, metals, and organic contaminants in water, sediment and biota. These programs are designed to observe basinwide effects of regulatory control programs, and more specifically, to define:

- spatial distribution of contaminants
- temporal trends
- contaminant sources
- new contaminants
- effects of mitigative action
- public health protection needs
- transboundary movement of pollutants
- ecosystem behaviour.

The following results illustrate some of the more significant findings.

The largest undertaking is the Sport Fish Contaminant Monitoring Program. Since the early 1970s, a wide variety of fish have been collected from over 1,700 lakes and rivers, including almost 200 locations along the Ontario shores of the Great Lakes. Fish are tested for a wide variety of organic and inorganic contaminants, residue levels are compared to health protection guidelines and, where warranted, consumption advisories are issued for use by the angling and fish consuming public. As part of the Sport Fish program, a number of locations in the Province have been tested at repeated intervals of time to document trends in the levels of certain substances. A full description of the program is contained in the Ministries of Environment and Natural Resources publication *Guide to Eating Ontario Sport Fish* which is published each spring.

Lake Ontario generally has the highest organic contaminant levels of the Great Lakes, however, long term monitoring of salmonid species has indicated very significant declines in recent years. The organic contaminants causing consumption restrictions on Lake Ontario sport fish are PCBs and mirex, but PCB levels have declined to the point where mirex is causing most of the consumption restrictions.

Coho salmon have been monitored at the Credit River since 1972 and the mean PCB levels have declined from over 10 parts per million (ppm) in 1972 to about 1 ppm in 1989 *[Figure 5]*. As well, all the 1989 coho from this sample were below the 2.0 ppm federal guideline for unrestricted consumption. As an example of the mirex declines, rainbow trout from the Ganaraska River area have been monitored since 1976 and the mean mirex

FIGURE 5

Mean Concentration of PCB in Coho Salmon Collected at the Credit River

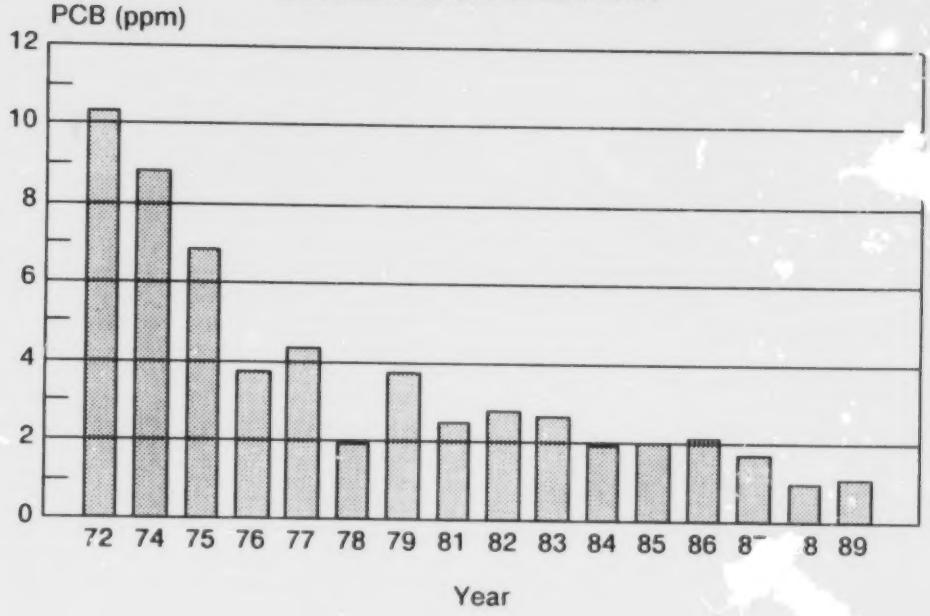
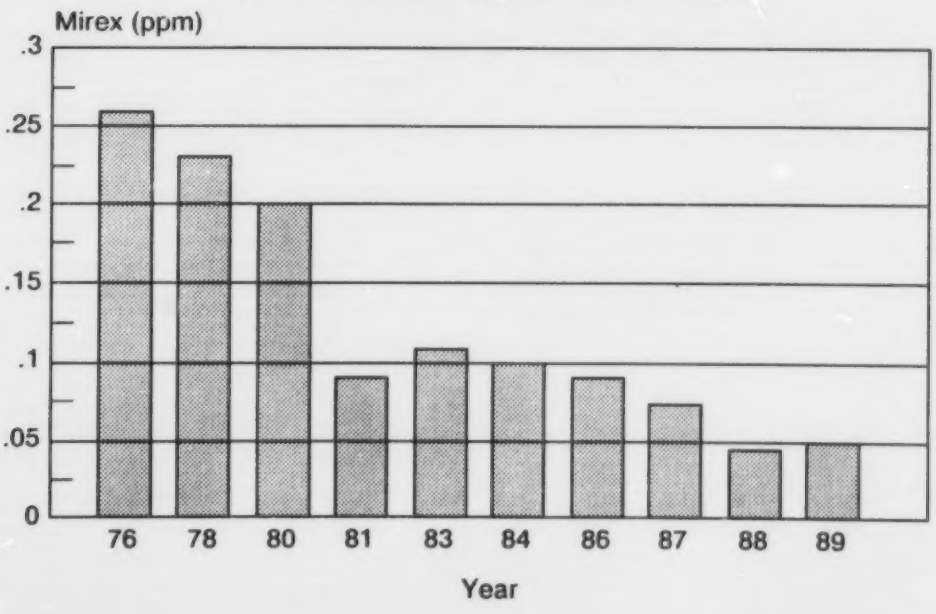


FIGURE 6

Mean Concentration of Mirex in Rainbow Trout from the Ganaraska River Mouth



values have declined from 0.26 ppm to the 1989 level of 0.05 ppm *[Figure 6]*.

As a result of these declines in organic contaminant levels, increasing sizes of salmonids are becoming suitable for unrestricted consumption. For example, rainbow trout up to 75 cm. (30 inches) are now suitable for unrestricted consumption.

Smallmouth bass fishing in the Long Point Bay area of Lake Erie has been popular for a number of years. Levels of PCB in this species have declined significantly since 1979; 1988 levels of PCB were reduced by over 90 per cent from the levels of 1979. No consumption restrictions are necessary on smallmouth bass (and many other species) from Long Point Bay on Lake Erie.

Monitoring of organic contaminants in the three geographical basins of Lake Erie has been conducted on a number of occasions in several species. PCB levels in coho salmon and white bass are lower in all three locations than they were some years ago, with white bass containing, on average, slightly less PCB than coho salmon. The PCB levels in Lake Erie sport fish are now at very low levels and with the exception of large carp at several locations, no species is restricted for consumption in Lake Erie based on PCB levels.

Chlordane levels in both coho salmon and white bass from all locations in Lake Erie have shown considerable declines since the late 1970s. This decline in levels in fish follows the decline in the amount of chlordane used as an agricultural insecticide. No restrictions in consumption of any species of Lake Erie fish tested is required because of chlordane.

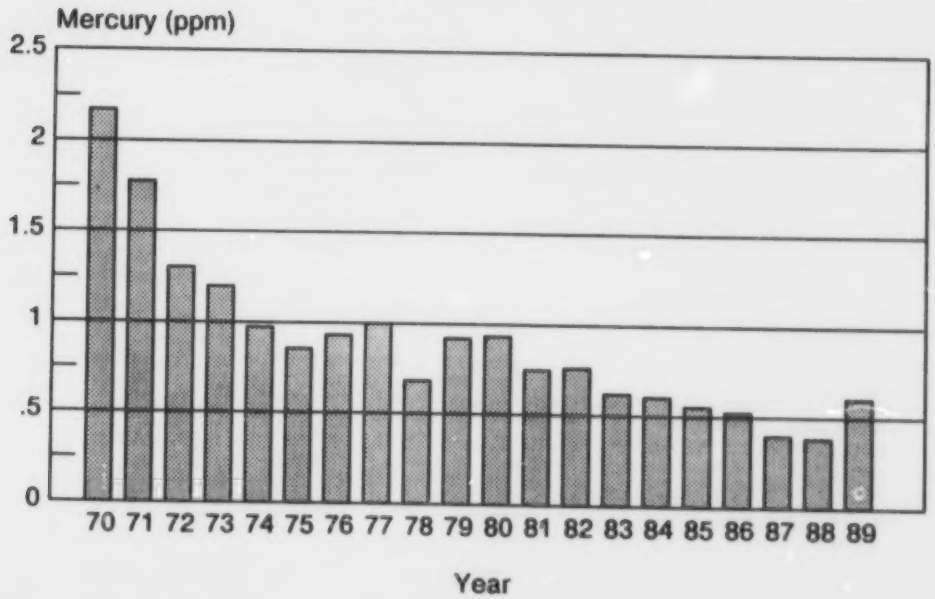
Mercury levels in Lake St. Clair sport fish declined significantly after 1970 when the discharge of mercury from a chlor-alkali plant on the St. Clair River was virtually eliminated.

As a top predator, walleye downstream in Lake St. Clair was the species most significantly affected by the mercury discharge, and in 1970 mercury levels were high enough that no size of walleye was suitable for unrestricted consumption. In subsequent years, mercury levels began to decline in all walleye in Lake St. Clair so that many are now suitable for unlimited consumption. Restricted consumption still applies to the larger walleye because of their long period of exposure to mercury, but even in these fish the trend data indicate that mercury levels are still declining *[Figure 7]*.

Levels of all organic contaminants have declined significantly in Lake Huron since the 1970s. Recent data indicates that only larger carp at a few locations are

FIGURE 7

Lake St. Clair Walleye
Mean Annual Mercury 1970-1989



restricted because of PCB levels above the 2.0 ppm guideline.

Lake trout, because of their slow growth and high fat content, are often the highest accumulators of organic contaminants such as PCB. Lake trout have been monitored in southern Lake Huron for a number of years and the PCB levels in 1988 were 150 per cent lower than those in 1976. Lake trout in southern Lake Huron are now below the 2.0 ppm federal guideline.

As is the case in the other Great Lakes, organic contaminant levels have shown marked declines in Lake Superior since the 1970s. PCB levels are still above the guideline for larger lake trout and siscowet (fatty lake trout) at several locations. However, long term monitoring at Peninsula Harbour has indicated that PCB levels have declined dramatically between 1976 and 1987 (from 3.7 ppm to 0.3 ppm) and all lake trout at this location are now well below the 2.0 ppm federal guideline *[Figure 8]*.

As well, mercury levels have declined sharply in those fish at Peninsula Harbour, and the present levels are about one-third of the 1976 levels *[Figure 9]*. Most of the lake trout now have mercury values less than the 0.5 ppm federal guideline for unlimited consumption.

Ontario also maintains juvenile fish testing programs in the Great Lakes and selected inland lakes. Residue levels of metals, industrial organics and pesticides are measured in young-of-the-year spottail shiners in the Great Lakes and young perch from inland locations. This program has some distinct advantages over adult fish testing programs. The exposure period is precisely known (time of hatch to collection) and the fish do not move very far from their place of birth.

PCB concentration reductions were found to be significantly linked with time in 30 per cent of the shiner collections from the Great Lakes. Similarly, concentration reductions correlated significantly with time in 33 per cent of the shiner samples for DDT, and in 26 per cent for chlordane. Mirex residue declines correlated with time in 25 per cent of the shiner samples collected from Lake Ontario and the Niagara River.

Although contaminant concentrations in the recent (1986-1988) shiner collections were generally much lower than concentrations in shiners from the mid-1970s, PCB, mirex and octachlorostyrene residues in shiners from some localities continued to exceed Wildlife Protection Criteria. PCB concentrations were in excess of the IJC Aquatic Life Guideline in 38 per cent of all the shiner collections from the Great Lakes. Likewise, mirex concentrations in shiners from Lake Ontario and the Niagara River exceeded the IJC Aquatic Life Guideline in 19 per cent of all the samples. Octachlorostyrene resi-

FIGURE 8

Lake Superior at Peninsula Harbour
PCB in Lake Trout 1976-1987

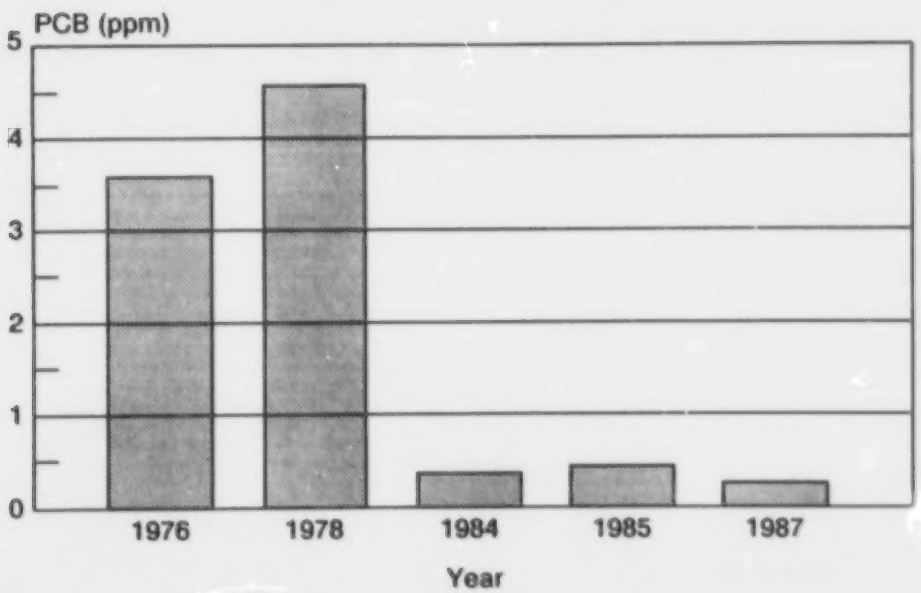
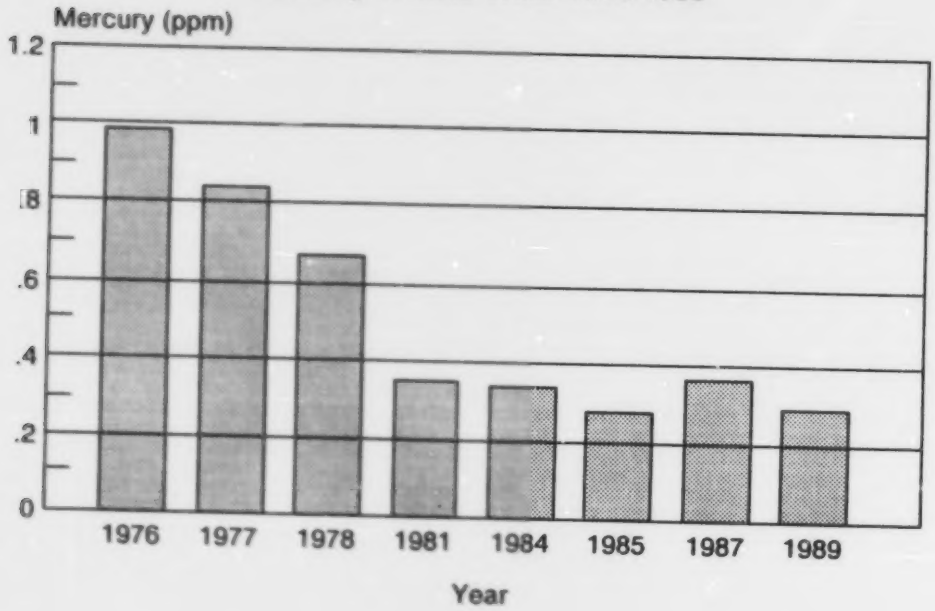


FIGURE 9

Lake Superior at Peninsula Harbour
Mercury in Lake Trout 1976-1989



dues exceeded the New York State Department of Environmental Conservation Fish Flesh Criterion in both of the St. Clair River collections.

Annual sampling of *Cladophora* for trends in contaminant levels at several selected sites in the lower Great Lakes and connecting channels commenced in 1981. Some of the most complete data comes from the Niagara River. Trends for PCB, mercury, lead and aluminum content of shoreline growths at six sites along the river generally show contaminant concentrations which are lower on the Canadian side of the River *[Figures 10-13]*.

The PCB content of *Cladophora* at three Canadian sites was variable over the decade. Fort George and Fort Erie samples had lower concentrations during the last few years of sampling. Frenchman Creek has not shown a time trend. Samples from three American sites had far higher PCB levels than the Canadian sites. Bloody Run Creek showed a trend towards decreasing levels over time, while Love Canal increased. Gill Creek samples had an enormous spike of PCB, over 80,000 ng/g in 1989.

The metals data show more consistent trends. The Canadian sites all increased in content of mercury, lead and aluminum from 1981 to a peak in 1983 or 1984 with subsequent decline to lower values in later years. The American sites followed a similar early 1980s peak and decline but show a disturbing trend towards increasing metals content in 1987, 1988 and 1989. The American *Cladophora* had far higher mercury concentrations than the Canadian side samples.

Since 1967, weekly raw (untreated) water samples have been collected from Great Lakes water intakes locations and measured for phosphorus, nitrogen, silica, conductivity, chloride, chlorophyll and phytoplankton biomass. Attached is a single figure *[Figure 14]* showing the annual mean values of nitrate-nitrogen and total phosphorus at eight water supply intakes in Lakes Erie and Ontario. Trend analyses of the weekly data show the following statistically significant trends: increasing nitrate-nitrogen at Kingston, Brockville, Union; decreasing total phosphorus at Dunnville, Bertie Twp., South Peel, Kingston, and Brockville.

It is important to note that the clearest increasing trends were over the period 1976-1985, however, since 1985 there has been a levelling out of nitrate-nitrogen levels at most sampling locations and a marked decline in the Dunnville intake samples. It is also important to note that the best defined phosphorus declines have been in Lake Ontario. The western basin of Lake Erie has not shown a clear long term decline in total phosphorus,

FIGURE 10a

Niagara River - Canadian Sites
PCB in Cladophora

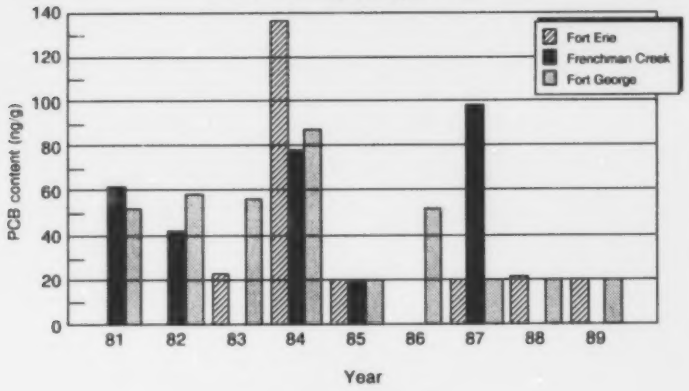


FIGURE 10b

Niagara River - American Sites
PCB in Cladophora

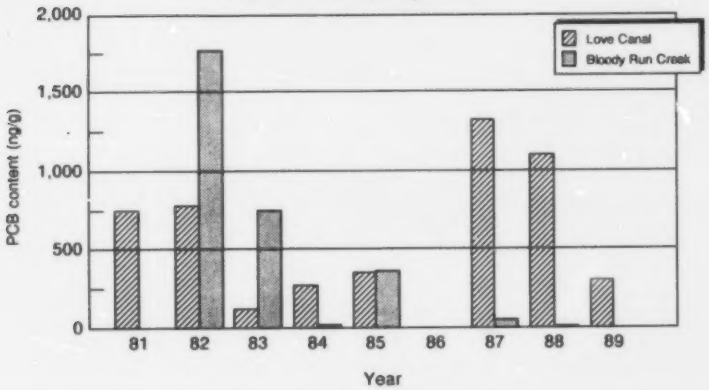


FIGURE 10c

Niagara River - American Sites
PCB in Cladophora

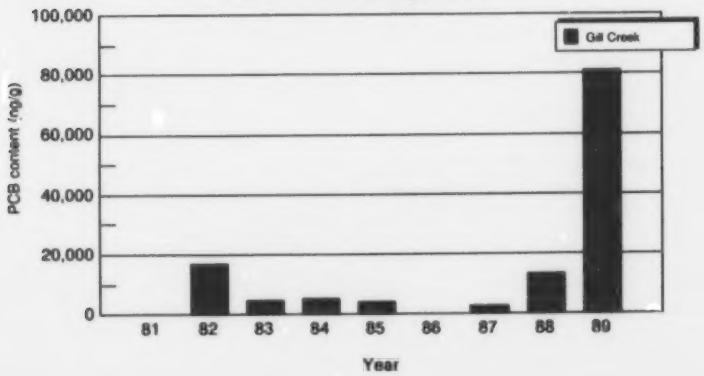


FIGURE 11a

Niagara River - Canadian Sites
Mercury in Cladophora

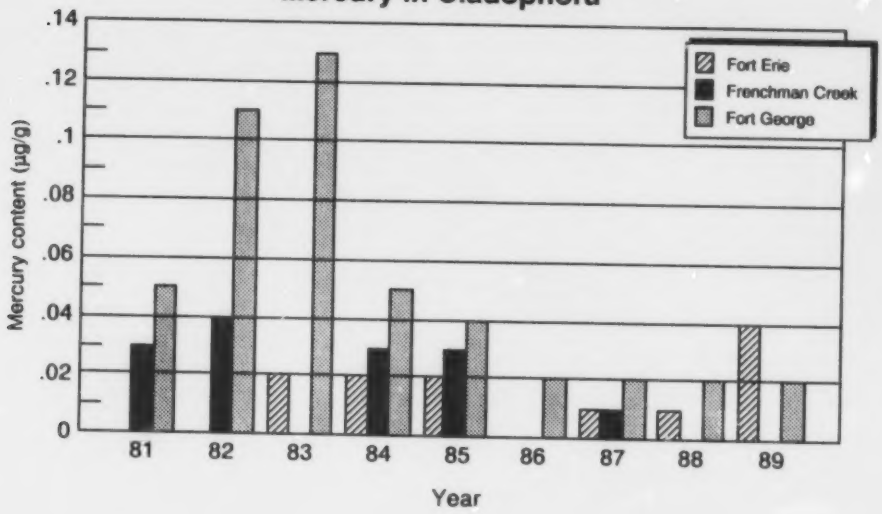


FIGURE 11b

Niagara River - American Sites
Mercury in Cladophora

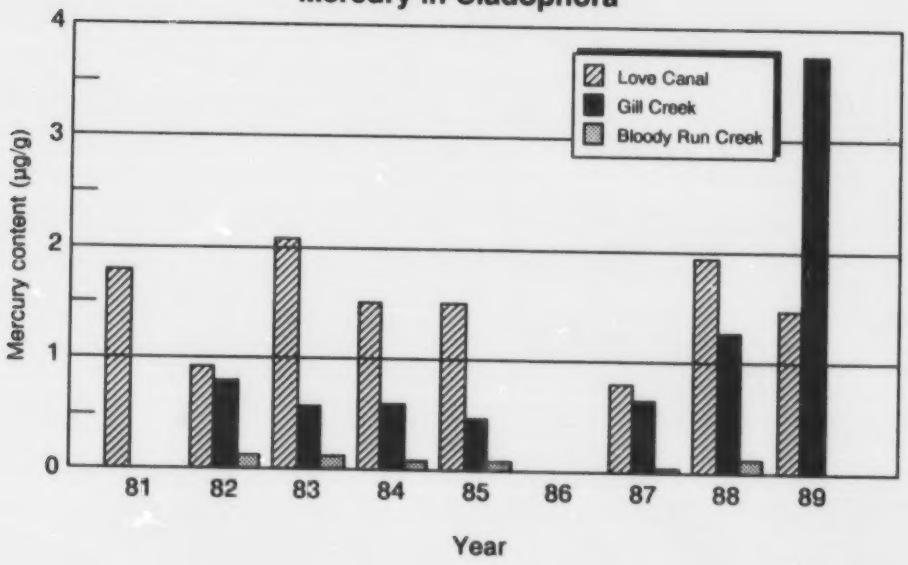


FIGURE 12a

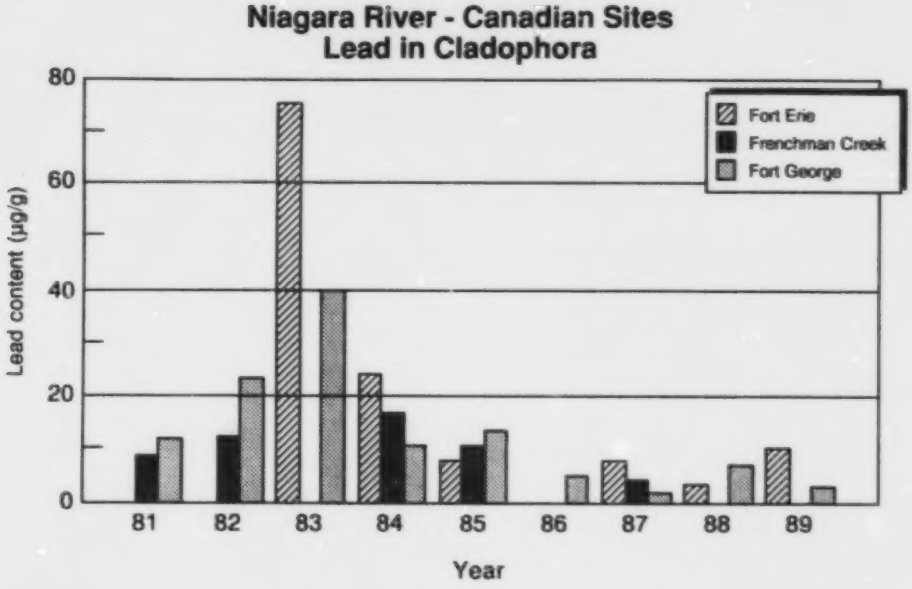


FIGURE 12b

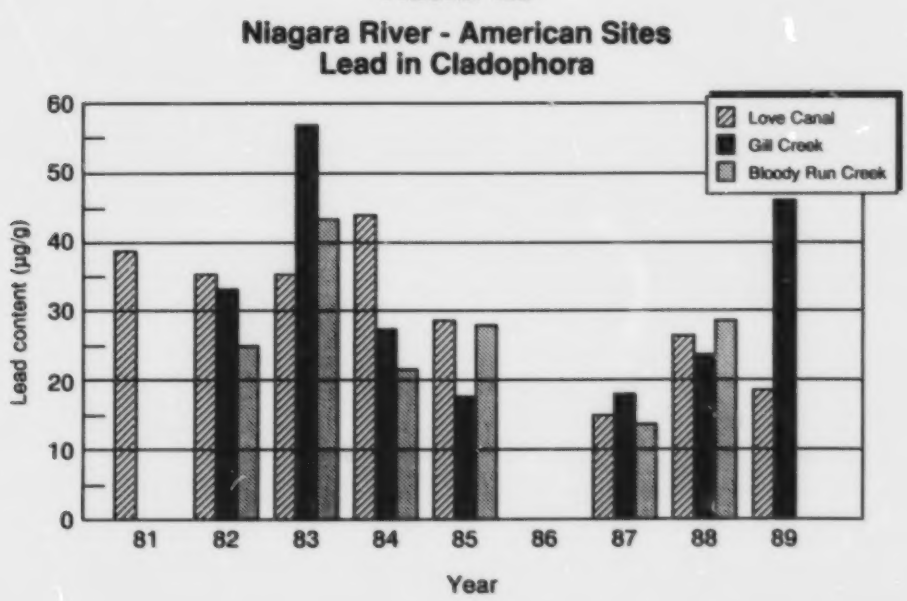


FIGURE 13a

Niagara River - Canadian Sites
Aluminum in Cladophora

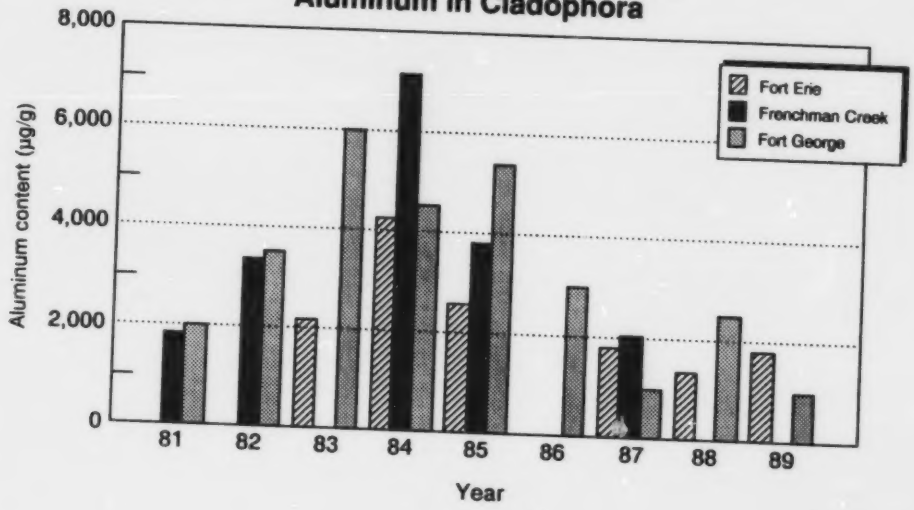


FIGURE 13b

Niagara River - American Sites
Aluminum in Cladophora

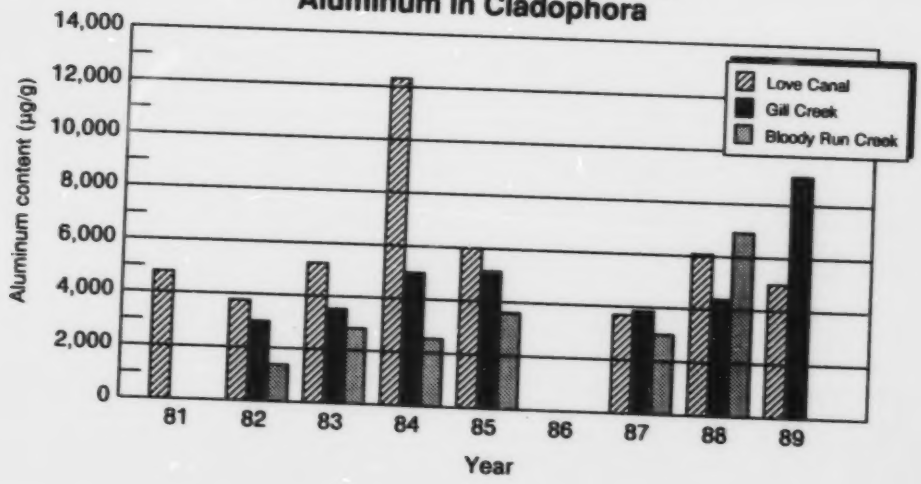
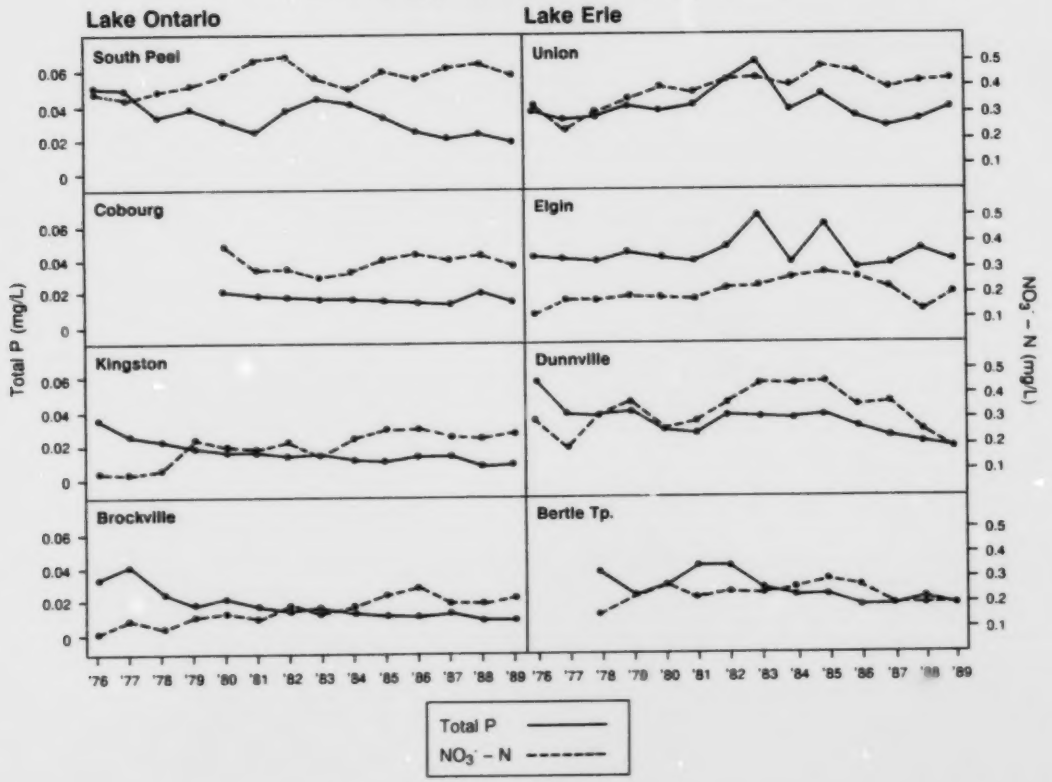


FIGURE 14

Lake Erie and Lake Ontario
Nitrate-Nitrogen and Total Phosphorus



and chlorophyll a concentrations at this site rose steadily over the period 1978 to 1987. Chlorophyll a levels decreased dramatically in 1989 and 1990 and are believed to be in response to the zebra mussel invasion of Lake Erie.

Two projects which were initiated in 1989, the Long Term Sensing Sites at Niagara River, and the Tributary Biomonitoring Program for Lake Ontario, are to be extended to other regions in future years. For the long term sensing sites program, 10 stations have been sampled in 1990 in Lake Ontario, 10 stations in Lake Huron will be sampled (i.e., 1991), then 10 stations in Lake Superior (1992) and then 10 in Lake Erie (1993). In the fifth year the 10 stations in Lake Ontario will be resampled, and so on. This approach will provide annual data on the five original Niagara stations, as well as a long term, five-year data base rotating through each of the Canadian Great Lakes.

A similar plan is proposed as an extension of the Lake Ontario Tributary Biomonitoring Program. This latter proposal will involve clam and small fish biomonitoring at the mouths of the 20 largest tributaries in a given Great Lake. As with the Long Term Sensing Sites, it is proposed that each lake will be visited on a rotating basis to provide a long term database to evaluate temporal changes associated with anticipated improvements in water quality and general ecosystem health of the Great Lakes.

The Ontario Ministry of Natural Resources continued its examination of the effects that changes in water quality are having on the structure and relative abundance of fish communities. Whole lake and individual species responses often give early-warning of new water quality problems and also serve as measures of the success of water quality improvement initiatives already undertaken. The general health of fish communities in the Canadian portion of the Great Lakes continues to improve. Where there are some problems with slow

recovery of some fish communities, the lack of suitable physical and chemical habitat is usually involved. The degraded habitats in Areas of Concern are significant examples. As well, the inability of lake trout to recover to self-sufficiency in eastern Lake Ontario is apparently related to organic solids precipitating over spawning gravel. High levels of organic pollutants in eggs and fry may also be inhibiting natural reproduction. The very large increases in fish biomass as top predators combined with significant reductions in primary nutrients like phosphates now control the size and numbers of forage fish species like smelt and alewife, and have added an increased element of stability to the entire fish communities. Conversely, fish managers are now examining overall requirements for phosphorus concentrations and what might be the sustainable size of the forage base once phosphorus loadings are reduced to the Agreement levels. The various fish community and habitat activities of the Ministry of Natural Resources that were supported and augmented by the Canada-Ontario Agreement have significantly contributed toward an understanding of how water quality and fish community objectives are inter-related.

Computer Modelling

Computer modelling is a tool used with increasing frequency by the Province. Toxic contaminant models are used for problem definition and evaluation of future conditions by interpretation and extrapolation of measured results, by analyzing the relative significance of different contaminant sources at any given location, and by evaluating the usefulness of proposed loading abatement measures. They are also used to evaluate the effectiveness of proposed remedial options to alleviate existing water use impairments (both spatially and temporally). Modelling also aids in the design of new intake and outfall configurations to prevent water use impairments.

The Province uses several types of toxic contaminant models in its assessments. Mathematical simulation or spill models have been developed and are applied to predict chemical concentrations at drinking water intakes along the St. Clair River, Lake St. Clair and Detroit River for quick and reliable assessment of accidental spills that occur from Chemical Valley Industries.

Fate and transport and aquatic food chain models are calibrated for selected short lists of key chemicals pertinent to specific discharges. The models are then used to assess the impact of discharged effluents on the receiving water, sediment and biota and are eventually used to derive water quality based effluent loading limits.

Hydrodynamic models are used to simulate the physical behaviour of nearshore water currents and exchange of waters between harbours and the open lake. These models are then linked with water quality models to show the movement and dispersion of chemicals.

Whole lake chemical mass balance models are used to simulate the toxic contaminant transport in large portions of a lake to aid in the development of Lakewide Management Plans.

The following modelling activities were carried out by the Province during 1989 and 1990:

- Thunder Bay Environmental Impacts
- Jackfish Bay Physical and Chemical Transport
- St. Marys River MISA Modelling
- Development of Spill Assessment Models for the St. Clair System
- St. Clair River MISA Modelling
- Detroit River Hydraulics Measurement Study
- Allied Chemical Plume Tracking
- Severn Sound-Georgian Bay Exchange
- Collingwood Harbour/Nottawasaga Bay Modelling
- St. Catharines Nearshore Circulation
- Toronto Harbour Exchange
- St. Lawrence River Hydraulic Measurements Study
- Cornwall Hydraulics (ACDP) Study
- Cornwall MISA Modelling
- Great Lakes Fate and Transport Modelling
- Oil Spill Model Modifications
- Outfall Assessment Modelling
- Sediment Wave Resuspension Model Development
- Rand Model Development
- Pharmacokinetic Modelling
- Assembly of Modelling Transformation Parameters for Inplace Contaminants
- Great Lakes Outfall Screening Assessment.

ANNEX 12:
Persistent Toxic Substances

Federal Activities

Programs and activities described within this section relate to the control of persistent toxic substances and preservation of the ecosystem.

Canadian Environmental Protection Act (CEPA)

The Canadian Government promulgated the Canadian Environmental Protection Act (CEPA) in June, 1988, as the legislative basis for the comprehensive management of chemicals in society. This Act provides a comprehensive framework for an ecosystem approach to environmental protection. It thereby complements the Fisheries Act by heightening the government's ability to control the release of toxic substances into the environment.

Environment Canada is compiling the Domestic Substances List (DSL) called for by CEPA. The DSL is based on chemicals imported, manufactured or used in Canada at a quantity of more than 100 grams per year between January, 1984, and December, 1986. A provisional list has been prepared and the final one is expected to be completed by December, 1990, or January, 1991. The list will play an important role in the comprehensive management of chemical substances in Canada. It will specify substances under the new substances provisions of CEPA. However, substances that are not on the List will require notification and assessment before they can be manufactured or imported into Canada. Notification information required from manufacturers and importers is prescribed by regulation and includes physical, chemical and toxicity data.

Environment Canada and Health and Welfare Canada are authorized by CEPA to compile a Priority Substances List (PSL) which gives priority in assessing whether substances are toxic or are capable of becoming toxic. In proposing this list, the departments received advice from two advisory bodies that consulted with academia, industry, environmental public interest groups, and provincial governments. A substance was listed if it met one or more of the following criteria:

(1) it causes or has the potential to cause adverse effects on human health or the environment;

(2) it accumulates or could accumulate to significant concentrations in air, soil, sediment or tissue;

(3) it is released or may be released into the environment in significant quantities or concentrations.

Substances that appear on Schedule I of CEPA ("List of Toxic Substances") have already been found to be toxic and are subject to regulations. Thus, they are not on the Priority Substances List. Substances that are not on Schedule I and for which control options are being developed are also not on the list. The toxicity of each substance on the list will be assessed, a report will be prepared and made available to the public, and the substance will then be removed from the list. For substances found to be toxic, the departments will indicate their intentions with regard to recommending regulations. Over 40 substances in three groups are being assessed over a five year period. As of December, 1990, two substances, polychlorinated dibenzodioxins and polychlorinated dibenzofurans, have been assessed and deemed to be toxic.

In Canada's Green Plan, the government of Canada commits to accelerating the assessment process and to complete the assessment of 100 priority substances by the year 2000, and to enact regulations for all those substances found to be toxic.

The Ontario Ministry of the Environment is informed of regulatory and other initiatives through its participation in the Federal-Provincial Advisory Committee established under CEPA and also through participation on various committees of the Canadian Council of Ministers of the Environment.

Concurrent with CEPA, the government has also released the Enforcement and Compliance Policy to facilitate compliance and to ensure that the Act is applied in an equitable manner across Canada.

Control of Municipal and Industrial Discharges

Releases from major single point sources and the need for reduction of industrial wastewater discharges continue to be major concerns for the federal government. The control of discharges has become an increasingly important strategy in improving environmental quality overall and in enhancing Great Lakes water quality.

In 1988, the two refineries subject to Petroleum Refinery Effluent Regulations were in 100 per cent compliance. This compares with a compliance rate of ninety-nine per cent in 1983. In 1988, only one violation was reported of the Chlor-Alkali Mercury Effluent Regulations for plants producing caustic/chlorine by the mercury cell process. In 1989, no violations were reported. From January to August, 1990, four exceedances were reported but these were attributed to the stirring up of sediment in the sewer and not to process upset.

Mining operations were in 86 per cent compliance with the Metal Mining Liquid Effluent Regulations in 1988.

In the pulp and paper industry the discharge of oxygen-consuming matters improved by six per cent between 1986 and 1988. Measures to control pollution from pulp and paper mills were the subject of public consultation in the spring of 1990. The measures consist of new regulations under CEPA to control the release of dioxins and furans as well as amendments to the Pulp and Paper Effluent Regulations under the Fisheries Act. The new measures will be fully in force by 1994.

The new regulations under CEPA will result in the virtual elimination of dioxins and furans from the bleaching process. Another regulation will limit the sale and use of defoamers and wood chips which result in the formation of dioxins and furans.

Amendments to Fisheries Act Regulations will set new limits on effluent discharges by establishing new procedures for effluent measurement and by making all mills subject to regulations governing the discharge of suspended solids, oxygen-depleting substances, and acutely lethal effluents. These amendments will take effect immediately upon proclamation. A closely monitored authorization system will be put in place to allow mills the time to install the proper equipment. More stringent site specific authorizations will be developed as necessary to protect sensitive fisheries; these will be based on findings from environmental effects monitoring to be conducted by the dischargers.

Further requirements will be developed to address releases of a wide category of organochlorine compounds discharged by pulp mills which use chlorine. The nature of these standards will depend on the result of an assessment report on effluents from mills which use bleaching. This report should be available in the summer of 1991.

National Water Research Institute Activities

A prerequisite for assessing the fate and effects of persistent toxic substances, as required in Annex 12, is the development of standard laboratory analytical techniques. Reference methods for dioxins and furans, polychlorinated biphenyls (PCBs), a variety of chlorinated organics, phenols and metals in sediment, water, effluent and biological material, have been developed at the institute over the past two years.

Research on the effects and the structure-activity relationships of a variety of hazardous compounds, which are known to be present in the Great Lakes, has also continued. The results of these studies have provided an understanding which will be useful, both for the prediction of the effects of new chemicals (which might be released into the environment in the future) and for the development of standards and guidelines for known contaminants.

Data have been compiled on the effects of over 500 toxic chemicals on the microorganism *Photobacterium phosphoreum*, commonly known as the Microtox test. This exhaustive compilation of literature and in-house data is useful for the interpretation and prediction of the effects of known and potential environmental contaminants. Research into inter-species and inter-endpoint correlations of the toxicity of single chemicals to a variety of aquatic and non-aquatic species, including the *Photobacterium phosphoreum* bacteria, algae, zooplankton, two freshwater fish species (fathead minnow and goldfish) and a terrestrial mammal (Norway rat), indicate a significant co-linearity of such data over a molar toxicity range of up to eight orders of magnitude.

In collaboration with university researchers and earlier research at the institute into quantitative structure-activity relationships of hazardous chemicals, quantitative correlations of molecular parameters with the *Photobacterium* toxicities were developed. While there are still certain shortfalls in predicting the effects of multiple substituted compounds, significant advances were obtained for several series. The toxic effects of a variety of nitrobenzene, aniline, phenol, chlorobenzene and related derivatives can be estimated for *ab initio* computed molecular electron density shifts in electron distributions at the oxygen atoms of the nitro group. This works particularly well for para-substituted nitrobenzene derivatives where large variations in toxicity are observed with relatively minor changes in chemical structure. These results confirm and extend our ability to predict toxic biological effects from chemical structure.

At the Great Lakes Laboratory for Fisheries & Aquatic Sciences, studies on the fate and effects of toxic chemicals are being examined. Specifically, the fate and effects of a large number of inorganic, organometallic, and organic chemicals are being examined on the abiotic and biotic samples. This information is required because of the need to examine the effects of chemical accumulation in different organisms from all trophic levels to

assess their overall impact from an ecosystem perspective. Some studies have focused on the behaviour of various chemical groups like chlorobenzenes, resin acids, dioxins and furans in various aquatic organisms to provide the database for structure-activity analyses. Other studies have examined the underlying mechanisms of chemical behaviour to refine predictive models.

Great Lakes Health Effects Program

The Department of National Health and Welfare under the Great Lakes Health Effects Program has initiated a number of studies to identify populations most at risk from the effects of Great Lakes pollutants and to provide the means by which individuals can reduce these risks to health. The Program, which has included public consultation to develop its objectives and strategic plan, involves the following activities:

- Examining cytoplasmic cell receptors (such as AH receptors) as indicators of acute or chronic exposure to certain organochlorine contaminants. This technique could be of value in relating exposure to body burden and potential health effects.
- Assessing the feasibility of utilizing biological markers to monitor human exposure to environmental contaminants and possibly to identify sensitive populations.
- Comparing exposure levels, target tissue contaminant levels and health outcomes in wildlife, laboratory animals and human populations. This collaborative work with the Canadian Wildlife Service will enable better use of animal research (laboratory and wildlife) as human health sentinels.
- Assessing in more detail, currently available data sets on both morbidity and mortality of human populations by specific location in the Great Lakes Basin. This work, which focuses on cancer incidence and mortality, birth defects and "other" causes of death, can be used to identify areas that may be in need of more detailed study.
- Conducting three population studies to determine the effects of human exposure to mixtures of chemicals. Two studies examine the effects of mixtures of contaminants in highly contaminated fish and wildlife (native and non-native populations) and one examines farm families exposed to herbicides or insecticides.
- Carrying out a series of toxicological evaluations of the effects of mixtures of Great Lakes chemicals on multiple generations, the delayed effects of exposure to lead and methylmercury on somatosensory function, the relative toxicity in mammals of several PCB congeners found in human tissues, and the effects of contaminants in follicular fluid on the development of the human ovum.
- Evaluating the importance of dermal absorption as a route of human exposure in the Great Lakes Basin.

Provincial Activities

Control of municipal and industrial sources of pollution

The Ontario Ministry of the Environment is giving high priority in reducing and controlling persistent toxic substances in the Great Lakes Ecosystem. Programs dealing with persistent toxic substances include:

- Municipal-Industrial Strategy for Abatement;
- Sewage Works Upgrades;
- Municipal and Industrial Direct Dischargers' Monitoring;
- Stationary Source Control;
- Vehicle Emissions Strategy; and
- Industrial and Municipal Waste Management Program.

Each of these programs is described below.

Municipal-Industrial Strategy for Abatement (MISA)

In 1980, Ontario enacted the Environmental Protection Act, which together with the Ontario Water Resources Act and the Pesticides Act, provide for a broad range of possible actions and regulations. One such undertaking is the Municipal-Industrial Strategy for Abatement (MISA) initiated in June, 1986.

The goal of the Municipal-Industrial Strategy for Abatement (MISA) is the virtual elimination of toxic contaminants from all industrial and municipal effluents discharging into Ontario waterways. The MISA goal is consistent with the general principle of Annex 12 of the Great Lakes Water Quality Agreement, which states that "the intent of programs specified in this annex is to virtually eliminate the impact of persistent toxic substances". The MISA program will systematically reduce water pollution at its source with enforceable regulations which become more stringent as abatement technology improves.

For direct industrial dischargers there will be two series of regulations: Effluent Monitoring Regulations and Effluent Limits (Abatement) Regulations. The Monitoring Regulations require the dischargers to measure the types, concentrations and total amounts of toxic substances present in their effluents. Resulting data will be used, with other information, to establish Abatement

Regulations. The end-of-pipe discharge limits will be based on Best Available Technology Economically Achievable (BATEA).

There are two regulatory components to the direct municipal dischargers program: the control of direct discharges from municipal sewage treatment plants, and the control of discharges to municipal sewers from industries (Sewer Use Control Program).

As of December, 1990, all industrial sector monitoring regulations have now been promulgated. Five industrial sectors have completed their year of intensive monitoring, while the four other sectors are under way.

To standardize procedures and criteria in developing Abatement Regulations, an issues resolution process is under way to resolve key issues common to all industrial dischargers. Representatives from the Ontario Ministry of the Environment, Environment Canada, the MISA Advisory Committee, industry and municipalities are participating in resolving these issues. Costs have been estimated for municipal compliance with various proposed sewage treatment plant regulations. Discussions are being held by the Ontario Ministry of the Environment and the Ontario Ministry of Municipal Affairs on the affordability of the proposed regulation. Possible strategies for assisting in implementation are also being considered.

The MISA Sewer Use Control Program will help eliminate the discharge of toxic contaminants and pollutants into sanitary sewers. To assist in the continued development and implementation of the program, the Ontario Ministry of the Environment is undertaking a number of projects. These projects include a Sewer Use Training Program for municipal staff, Municipal Demonstration Projects to determine the practicality of the sewer use program and the development of a Computerized Data Management System. Approximately twenty municipalities have already promulgated new sewer use by-laws which are based on the 1988 Model By-Law. These twenty municipalities represent about 60 per cent of Ontario's population.

The MISA Program principles are being scrutinized at this time. Additional methods of reducing pollution, including such concepts as zero discharge of hazardous contaminants and the reduction of pollutants at source (pollution prevention) are being considered by the provincial government.

Public Consultation for the Municipal-Industrial Strategy for Abatement (MISA).

MISA is committed to full public participation of its abatement strategy. It is recognized that full participation of affected municipalities, industries and the public is vital to the success of the program. The general public, as well as interest groups, have significant opportunities for involvement throughout the development of MISA regulations. Beginning with the 60-day public review of the White Paper announcing the MISA program, the commitment to involving the public in the regulation-setting exercise extended to include public review of draft monitoring regulations.

Public consultation has been ongoing during development of the abatement regulations, which is currently under way. Further opportunity for public input into MISA will be available once draft versions of the abatement regulations are released for review and comment. As well, the Ontario Ministry of the Environment is committed to providing the public with complete access to data on containment discharges and on the effluent limits set for all discharges once the abatement regulations are in effect.

Sewage Works Upgrades

The Province of Ontario is continuing to provide transfer payments to municipalities for upgrading and expanding sewage treatment facilities and collection systems. In addition to the Direct Grant Program the Province also contributes grants to municipalities under the LifeLines Program.

The LifeLines Program goal is to improve and protect the quality of ground and surface waters. The program provides financial assistance to municipalities to develop and plan for remedying existing water pollution problems, and to assess and rehabilitate water and sewer lines. Since 1986 the Province has contributed over $25 million and $35 million for studies and rehabilitation work under this program.

Industrial and Municipal Direct Discharger's Monitoring

The Province of Ontario continues to report annually on both Industrial and Municipal Direct Discharges. The *1988 Municipal Discharge Report* provides a comprehensive summary of the performance of all sewage treatment plants in Ontario. Three parameters (Biochemical Oxygen Demand, Suspended Solids and Total Phosphorus) were assessed and compared to the Ontario Ministry of the Environment Sewage Effluent Guidelines defined in Policies 08-01 and 08-04. The *1988 Municipal Discharge Report* also assessed a large proportion of sewage treatment plants against the effluent limits stipulated in their Certificate of Approval.

The *1988 Industrial Discharge Report* provides average monthly effluent flow and loads discharged by source, actual loadings versus effluent limits on a monthly and annual basis, tables of remedial actions for sources not meeting limits criteria and a table of new Ontario Ministry of the Environment enforcement actions.

The Ontario Ministry of the Environment reports sewage treatment plant discharges including total phosphorus on a monthly basis. Compliance limits for effluent concentrations are still set to one milligram per litre on an annual basis. Work is being carried out to revise the phosphorus compliance limits.

In areas that have limited receiving assimilative capacity (i.e., the Grand River) sewage treatment plant expansions are restricted to the phosphorus loads of the pre-expansion facility.

The Ontario Ministry of the Environment, Environment Canada and the Municipal Engineers Association (MEA) sponsored the *Thirty-Seven Municipal Water Pollution Control Plants Study* to provide information necessary to support the development of a cost-effective and practical monitoring regulation. Thirty-seven sewage treatment plants were monitored including 28 secondary treatment plants, seven primary treatment plants and two lagoons. Influent and effluent flows and raw and treated sludge were collected for one to two consecutive five-day periods. The monitoring list included 122 organic contaminants, 15 metals and conventional contaminants.

The Ontario Ministry of the Environment and Environment Canada are sponsoring the *Acute and Chronic Toxicity Evaluation of Ontario STP Effluents*. The study is assessing the lethal and sublethal effluent toxicity from ten sewage treatment plants for both summer and winter conditions. Acute toxicity tests using rainbow trout and Daphnia magna are being examined. Chronic fathead minnow survival and growth tests and Ceriodaphnia dubia survival and reproduction tests are also being carried out.

Stationary Source Control

Ontario is currently developing a new regulation to replace Regulation 308 as the principal regulation under the Environmental Protection Act controlling emissions to air from stationary sources. Most importantly, the Ministry will introduce emission limits on facilities or processes to replace the dilution policy in Regulation 308.

A detailed program description titled the Clean Air Program was released in August, 1990, for a 180-day public comment period. The proposed regulation requires significant air pollution sources to: meet emission limitations based on the hazardous nature of the contaminants being emitted; demonstrate predicted compliance with strict community air quality standards using state-of-the-art dispersion models which take into account all neighbouring sources; have a renewable (every ten years or upon change of the ownership of the facility) certificate of approval to construct and operate; comply with specific monitoring requirements; and register emissions to the atmosphere on an annual basis.

Vehicle Emissions Strategy

The Ontario Ministry of the Environment is currently developing a comprehensive plan to control vehicle-related emissions through regulatory and educational programs. It has been estimated in Ontario (1985) that 26 per cent of the carbon dioxide, 64 per cent of the carbon monoxide, 63 per cent of the nitrogen oxides, 46 per cent of the volatile organic compounds and 64 per cent of benzene compounds were generated by mobile sources. These emissions are associated with such concerns as greenhouse gases, ground-level ozone, acid rain and airborne toxic emissions.

The proposed strategy to deal with these problems involves improved emissions control for cars and trucks, improved fuels and improved distribution systems. The Ontario Ministry of the Environment will be taking cooperative action with the Ontario Ministry of Transportation, as well as other provincial and federal agencies.

Industrial and Municipal Waste Management Program

Ontario's Waste Management Program is regulated under the provincial Environmental Protection Act. The regulation sets out a chain of responsibilities from waste generation through transportation and disposal in controlling liquid industrial and hazardous wastes.

In June, 1987, the Ontario Government announced the $9 million Comprehensive Funding Program (CFP) for waste management, which provides financial assistance to municipalities and the private sector for waste management activities. These activities include waste management (treatment and disposal); municipal and industrial waste reduction, reuse, and recycling; Student Action For Recycling Program (STAR); the Household Hazardous Waste Program (collection events/facilities); and storage of PCBs.

Waste Management Program

The Waste Management Program is a grant assistance program, which provides municipalities with funding for monitoring, technical evaluation and long term waste management planning. Sub-components of this program are described below:

- The Waste Management Improvement Program (WMIP) provides funds to municipalities to upgrade sites, close sites properly and investigate and propose remedial works. Technical projects undertaken include hydrogeological studies; a site operation and development plan; a contin-

gency plan; leachate and methane monitoring; creation of an on-site buffer area; and site closure.

To date, 1,550 projects at a cost of $14 million have been funded. In 1990-1991, 98 projects requiring $4.5 million will be supported.

- The Waste Management Master Plan (WMMP) provides funds for groups of municipalities for the development of comprehensive long range (20 years) waste management plans that incorporate system components to minimize the use of landfill, while considering alternatives such as reduction, reuse and recycling.

  Forty-four studies are currently under way. Two have been completed (North Easthope Group and Waterloo Region). The budget allocated for fiscal year 1990/1991 is approximately $1.9 million.

- Financial Assistance Program (FAP) was introduced in 1987 to effectively bridge the funding gap between the Waste Management Master Plan and the Waste Management Improvement Program (planning and operating phases). The Financial Assistance Program assists municipalities in establishing landfills, transfer stations, Household Hazardous Waste depots or processing facilities.

  Since 1989, 140 projects were approved and $14.3 million has been provided to municipalities to support the development of new waste management facilities. In 1990-1991, 85 projects have received a commitment for funding totalling $10 million.

Municipal Waste Reduction, Reuse, and Recycling Program:

The Municipal Waste Reduction, Reuse, and Recycling Program provides grant assistance for diverting waste away from landfill sites. Four components of this program are described below:

- Municipal Recycling Support Program (MRSP): MRSP subsidizes capital purchases and operational expenses associated with the recycling projects. Furthermore, MRSP provides grants for demonstration projects, educational programs and feasibility studies. Typically, the projects funded involve the collection of recyclables at curbside from single family dwellings. Projects using depot collection systems in rural areas are also funded. Materials recovered by recycling projects are typically newspaper, glass containers, metal cans and plastic soft drink containers.

  Total spending by the Ontario Ministry of the Environment under the MRSP from 1986 to 1989 has been 29.7 million. In 1989-90, the MRSP expenditure was $17.7 million to support 107 recycling projects in 340 municipalities and over 250,000 tonnes of materials were diverted from landfill. The budget for 1990-1991 is $21.2 million. Municipal recycling is expected to divert over 340,000 tonnes of material this fiscal year. By the end of 1990, approximately 2.5 million of Ontario's 3.7 million households will have access to multi-material programs.

  The Ontario Ministry of the Environment will promote the addition of fine paper, mixed plastics, film plastics, corrugated cardboard, boxboard and large items (appliances, furniture, etc.) in municipal recycling projects.

- Municipal Reduction/Reuse Program (MRRP): MRRP provides grants to municipalities for activities which are aimed at changing consumer attitudes or behaviour with respect to waste generation habits (e.g., home composting and discouraging purchase of overpackaged goods). The most popular grant under this program is for home composting units. To date, the Ontario Ministry of the Environment has approved or is in the process of approving grants to 160 municipalities totalling over 240,000 bins representing a financial commitment of $3.8 million. By 1991-92, it is expected that 160 new municipalities will request an additional 260,000 backyard composters requiring $6.8 million of Ontario Ministry of the Environment support.

- Student Action for Recycling Program (STAR): STAR is available to elementary and secondary schools. Capital items such as collection equipment, building modification, materials safety and monitoring equipment and vehicles are eligible for up to two-thirds funding. The objective of the program is to implement recycling within five years in all schools in the Province.

  The full-scale recycling program for schools was announced in October, 1989. This program has an estimated Ontario Ministry of the Environment funding requirement of up to $10 million (over five years). To date, 15 school boards with a total of 828 schools have been approved for grants totalling $685,625. The total estimated recyclable material (initially diverted from landfill) is 2,300 tonnes per year.

Industrial Waste Reduction, Reuse, and Recycling Program

The industrial program provides assistance for all industrial and commercial sectors to take advantage of new opportunities for waste diversion from disposal. This program provides financial and technical assistance

to explore beneficial uses of commercial and industrial wastes and their reduction. Activities eligible for funding include feasibility studies, process or equipment modification or evaluation, demonstration of technology and research. Wastes such as cardboard, rubber, plastics, solvents and CFCs are included in this program. Two hundred and thirty-six projects, at a cost of $16.6 million have been funded since 1986, diverting 712,000 tonnes of non-hazardous wastes and 74,000 tonnes plus 92 million litres of hazardous wastes annually.

Household Hazardous Waste Program (HHWP)

The purpose of this program is to provide grants to municipalities for programs to collect household hazardous waste. These programs can involve locked-lid boxes with householders who can then store wastes such as batteries, paints and other dangerous products.

To date, funding has been allocated for permanent Household Hazardous Waste disposal depots. This initiative has increased the mass of household hazardous waste diverted to depots from 35 tonnes in 1986 to more than 400 tonnes in 1990. A forthcoming Ontario Ministry of the Environment document, entitled "Guidelines for the Establishment of Permanent Household Hazardous Waste Collection Facilities", is due to be published in 1991. This guideline will evaluate household hazardous waste collection methods used by other jurisdictions. It will assess various case studies including permanent collection depot, collection day depot, selective collection, combination of permanent depot with collection day and phone-in, pick-up service in Ontario and other jurisdictions.

Polychlorinated Biphenyls (PCB) Storage

Environment Canada is preparing a PCB storage regulation under the Canadian Environmental Protection Act to replace the existing Interim Order on Storage of PCBs. To ensure that Ontario retains its control over PCB waste handling and storage, the two governments are working jointly to develop an equivalency agreement.

ANNEX 13:
Pollution from Non-Point Sources

The programs and measures for abatement and reduction of non-point sources of pollution from land use activities include efforts to further reduce non-point source inputs of phosphorus, sediments, toxic substances, and microbiological contaminants contained in drainage from urban and rural land, including waste disposal sites, in the Great Lakes System. In accordance with the requirements of Annex 13, the following activities relating to pollution from these sources are to be carried out:

(i) identification of land-based activities contributing to water quality problems;

(ii) development and implementation of watershed management plans;

(iii) identification, preservation and, where necessary, rehabilitation of significant wetland areas that are threatened by urban and agricultural development and waste disposal activities;

(iv) undertaking appropriate surveillance and survey programs and demonstration projects as outlined in the Annex; and

(v) reporting to the International Joint Commission biennially, beginning in December, 1988, on the progress of implementation of Annex 13.

The Non-Point Source Committee, which was established under the Canada-Ontario Agreement Respecting Great Lakes Water Quality (COA), ensures that programs and measures are developed to achieve these requirements. Federal and provincial agencies have continued to implement initiatives to reduce urban and rural non-point source pollution, and to ensure the preservation of wetlands. The following provides an update on the progress which has been made.

Rural Non-point Source Pollution

Toxic Substances

The introduction of pesticides from diffuse sources into surface and groundwater remains a key concern in rural areas. The programs and measures which are implemented under Annex 13 also support Annex 16 which deals with contaminated groundwater.

Reduction in Pesticide Use

The Ontario Ministry of Agriculture and Food (OMAF) is continuing the Food Systems 2002 program to reduce pesticide use on agricultural crops by 50 per cent by the year 2002. Two major objectives of the program are to maintain efficient and sustainable crop production through the development of environmentally sound techniques; and to help increase grower awareness, while decreasing grower costs and the pesticide load in the environment.

The program is a co-ordinated approach emphasizing three main areas: Research, Education and Field Delivery of pest monitoring and management strategies. The total budget for the first five-year phase of the program is $10 million. Budget allocations to key areas include: Research $5.6 million, Education $1 million and Field Delivery $3.4 million.

The program continues to be an extremely effective method of providing technology which ensures utilization of the most appropriate forms of pest management. Under the Education component, the Grower Pesticide Safety Course (GPSC) has been delivered to approximately 11,500 growers. A total of eight Pest Management Advisors have been hired under the field delivery component to conduct feasibility studies and on-farm demonstrations, and to develop strategies for selection and timing of pest control options in the Great Lakes Basin.

The Ontario Ministry of the Environment has also made a number of changes to Regulation 751 under the Pesticides Act to ensure more stringent requirements for the sale, use, storage and transportation of pesticides in Ontario.

A review of the Canadian pesticide registration process is currently being undertaken by Agriculture Canada, which is the agency responsible for the registration of pesticides for use in Canada. The purpose of the review is to formulate recommendations with a view to ensuring the efficient federal regulation of pest control products that minimize the risk of harm to human health, safety and the environment while meeting the needs of stakeholders.

Monitoring and Surveillance

Environment Canada has undertaken monitoring of runoff in the Thames River Basin to determine the impacts of agricultural herbicides used in corn production on the water quality of small streams. Water and sedi-

ment samples were analyzed for herbicides including atrazine and metolachlor.

Monitoring of herbicides and nematocides in the Big Creek Watershed on Lake Erie is also ongoing. A recently initiated program on tributary loadings and rural non-point source pollution will address loading calculations, monitoring procedures, ecosystem health indicators, and characterization and control of rural non-point source pollution in the Great Lakes Ecosystem.

The Ontario Ministry of the Environment, with assistance from the Ontario Ministry of Agriculture and Food, continues enhanced pesticide sampling at three large tributaries situated in the Great Lakes Basin, including the Grand, Thames and Saugeen Rivers.

Research

Both federal and provincial agencies are involved with studies related to the fate and transport of pesticides in surface and groundwater in Ontario.

The Ontario Ministry of Environment funded a three year pesticide study on atrazine in southwestern Ontario watersheds. This study has been completed and a consultant's report has been published. The Ministry is currently funding a research project which is assessing the effect of agricultural tile drainage on pesticide losses.

Environment Canada has studied the transport of sediment and chemicals from agricultural land in a research catchment and the modelling of such transport is currently under way.

Agriculture Canada has initiated several studies related to the introduction of pesticides to surface and groundwater during the past year. Studies are under way to develop field crop production systems that have reduced chemical requirements. Pesticide transport, dissipation, and modelling projects have been initiated for conventional and conservation cropping systems. Physical-chemical parameters that control pesticide persistence and leaching as well as enhanced microbial degradation of pesticides are topics being investigated that could lead to the control of pesticide pollution of surface water. Agriculture Canada is also conducting a biomonitoring study of the distribution of arthropods in first order streams to establish species sensitivity to common agricultural chemicals.

Conventional Pollutants

Both federal and provincial agencies have implemented programs and measures to further reduce the loss of sediment in runoff and corresponding losses of sediment associated nutrients, bacteria and chemicals. Some of these programs also have research and demonstration components.

Pollution Reduction Through Best Management Practices and Soil Conservation

The Land Stewardship Program (LSP) of the Ontario Ministry of Agriculture and Food was a three year, $40 million program, which ended August 31, 1990. The program provided financial incentives for the adoption of conservation farming practices on Ontario farmland to improve soil resources and water management by minimizing the potential environmental contamination from agricultural practices. LSP consisted of four components which included: 1) Financial Assistance $31.3 million; 2) Research $3.3 million; 3) Extension/Education $2.4 million; and 4) County Program Delivery $3.0 million.

Grant incentives were available under four sections of the financial assistance component, including: a) *soil structure* - to encourage crop rotation, increase residue cover, tree planting and incentives for landlords to require tenants to adopt conservation practices; b) *soil erosion structures* - to encourage good maintenance of open municipal drains: money was available to encourage environmental enhancements (e.g., buffer strips, erosion control devices, livestock access control); money was also available to encourage the use of soil conservation structures under the Ontario Soil Conservation and Environmental Protection Assistance Program II (See OSCEPAP II description provided in Annex 3 under SWEEP Sub-program 6 - Soil and Water Conservation Incentive Grants); c) *conservation equipment* - farmers received grants to rent residue management equipment; and d) *technical training* - for conservation training courses as well as on-farm instruction.

Funds available through the research component were administered by the Agricultural Research Institute of Ontario. Projects approved were directly related to soil stewardship. The funds were allocated quickly and most projects are in their final year. Under the extension/education component, Soil Conservation Advisors worked out of the Ontario Ministry of Agriculture and Food county offices with farmers. These staff advised producers on all aspects of "conservation management" through farm visits, workshops, committee meetings, and stewardship events. A contract was signed with the Ontario Soil and Crop Improvement Association (OSCIA) under the county program delivery component to promote the program, accept applications and inspect completed projects.

The Land Stewardship Program resulted in increased financially-assisted erosion-protection of agricultural soils on an average of 107,000 hectares annually in the Great Lakes Basin. This was achieved through the use of conservation tillage, cover crops, increased planting of forages and the planting of trees.

By reducing soil erosion, there is an associated reduction in soil-bound nutrients and pesticides.

The program has also helped fuel a growing environmental awareness and stewardship ethic within the agricultural community. The Ontario Soil and Crop Improvement Association (OSCIA), a county-based farm organization, has been a key component in the administration and promotion of the program on a provincial and local basis. By involving the OSCIA, Ontario has fostered the leadership and voice for conservation within the agricultural community.

Land Stewardship II is a $48 million four year program commencing in 1990, which extended the current Land Stewardship Program. This new conservation program combines several elements of the previous Land Stewardship Program and OSCEPAP II, with the addition of new water quality initiatives. The new program will integrate the use of agricultural practices and structures, promote conservation farm planning, and continue to involve farmers in program delivery. Agricultural practices include residue management and cover crops. Also included are structures related to manure storage, milkhouse waste-water treatment systems, pesticide storage and handling stations, soil erosion control, watercourse fencing and livestock watering facilities.

The inclusion of structures into the program promotes an integrated resolution of on-farm soil and water resource problems. These structures will also positively impact the off-farm environment, which will benefit rural water quality and ultimately the Great Lakes Ecosystem.

The program will also develop field-level information through on-farm demonstrations which farmers need to make conservation planning decisions. Participants of the program are required to complete a conservation farm plan which includes an inventory of the farm's soil and water resources and an action plan or list of options for addressing problems related to managing and conserving those resources.

More than 5,000 farmers are expected to participate in Land Stewardship II over the next four years. The county program delivery committees are in place and the implementation of practices will begin April 1, 1991.

The National Soil Conservation Program (NSCP) is a three year program which runs until March, 1993. In Ontario, a total of $22 million has been committed under the program. The $11 million federal component has allocated $8 million to a permanent cover program. This will remove fragile lands from annual cropping and will create buffer strips to protect watercourses from cropland runoff. The remaining $3 million is being used for research and monitoring of soil conservation and quality, as well as public awareness. The Province's $11 million contribution is part of the Ontario Ministry of Agriculture and Food's Land Stewardship Program, which was described above.

Agricultural drainage projects which are implemented under the *Drainage Act* must include sound planning and design in their construction to provide a drainage scheme which properly fulfils its intended role at a reasonable cost to individuals and society. The objective of a properly engineered and constructed project is to provide, within the scope of the project, maximum performance at a minimum total cost over the life of the work, while at the same time providing protection for the environment. The adverse impact of an improperly planned drainage project may include streambank erosion and sediment impacts, including turbidity and impacts to aquatic habitats.

The second edition of the Design and Construction Guidelines, which were published in 1986, are currently being utilized in the design of drainage projects and will continue to be updated regularly. These guidelines were prepared co-operatively by the Ontario Ministries of Agriculture and Food, Natural Resources, Environment, and the Association of Conservation Authorities of Ontario. The goal of the guidelines is to provide protection for the environment and conservation interests through design and construction practices which minimize the impacts of drainage projects on the environment. The guidelines recommend the use of various erosion control measures to minimize environmental degradation, including: buffer strips, revegetation, fencing, tile outlets and sediment basins.

The Soil and Water Environmental Enhancement Program (SWEEP) was initiated in 1985 as a component of the Canadian Federal-Provincial Phosphorus Load Reduction Plan. A major goal of the program is to reduce phosphorus loadings by 200 tonnes per year in the Lake Erie Basin from agricultural non-point sources. The total budget for this joint federal-provincial program is $30 million. A detailed discussion of the progress made through SWEEP is provided under Annex 3 - Control of Phosphorus.

The Partners in Nitrogen Study began in February, 1990, as a joint effort of the Fertilizer Institute of Ontario, the Universities of Guelph and Waterloo, and the Ontario Ministry of Agriculture and Food. This new nitrogen management program is primarily a research and demonstration pilot project to establish an improved system for nitrogen recommendations to ensure nitrogen fertilizer management which will provide an economic response while minimizing nitrate transport out of the root zone into the groundwater. This program also supports Annex 16 which deals with pollution from contaminated groundwater.

The first year of the program has been spent developing the field research methods and establishing the co-operators. The program involves the use of some 35 pilot sites around the Province, with different soil and climatic conditions, which will be tested with various application rates of nitrogen fertilizer. The program will run through until December 31, 1993.

Watershed Studies

The Rural Beaches Program which was introduced by the Ontario Ministry of the Environment in 1985 is currently in its sixth year. A total of $1 million was committed to the program during 1989 and 1990. The program provides funding to Conservation Authorities for the investigation of specific beach problems and the development of Clean Up Rural Beaches (CURB) Plans. The CURB Plans identify rural non-point sources of bacteriological contamination which are impacting on rural beaches.

To date, nine CURB Plans have been received for studies initiated since 1985. These include: Grand River, Ausable-Bayfield, Upper Thames River, Otonobee Region, Maitland Valley, Grey-Sauble, Lake Simcoe Region, Metro Toronto and Region, and Timiskaming Health Unit. Options for implementing these plans are currently being developed by the Ontario Ministry of the Environment. Some implementation of remedial measures to improve water quality has occurred in all of the study areas through the Ontario Ministry of Agriculture and Food's Ontario Soil Conservation and Environmental Protection Assistance Program II (OSCEPAP II) and the Ontario Ministry of the Environment's Enhanced OSCEPAP II Programs. The Enhanced OSCEPAP II funding program provided $600,000 for remedial measures on farms during 1989 and 1990.

As CURB Plans are completed additional watershed studies will be considered for funding on a priority basis under new agreements with the Conservation Authorities. Since 1988, studies have been initiated with six Conservation Authorities, including: Essex Region, St. Clair Region, Long Point Region, Halton Region, Rideau Valley, and Raisin Region.

Monitoring and Surveillance

During 1990, Environment Canada increased its efforts for monitoring suspended sediment in tributaries to the Great Lakes by expanding its network of stations. Sediment sampling, integrated with water quantity gauging, is now conducted on 16 major tributaries and at approximately 100 additional sites in the Great Lakes Basin. Sampling is designed to cover a range of flows so that annual estimates of suspended solid loadings can be derived. The data will also be used for designing sampling programs and interpreting data for contaminants associated with sediment transport.

Urban Non-point Source Pollution

Urban drainage contributes significant diffuse source inputs of sediments, phosphorus, bacteriological contaminants and toxic substances to the waters of the Great Lakes System. Urban drainage includes stormwater runoff and combined sewer overflows (CSOs). These CSOs carry both wet weather surface runoff and sanitary sewage which are a major cause of water quality degradation. The following provides an update on the programs and measures which are currently in place to control urban non-point source pollution.

Urban Drainage Management

A new policy initiative is currently being developed under the direction of the Ontario Ministries of Natural Resources and the Environment to accomplish the objectives of urban drainage in new development. The policy is designed to integrate with the Province's land-use planning process and will be implemented within the existing mandates of provincial agencies who are involved in land-use planning, review and approval.

When fully implemented, the policy will be supported by a number of technical guideline documents. Two of the technical documents, the *Urban Drainage Design Guidelines and the Guidelines on Erosion* and *Sediment Control for Urban Construction Sites*, are used voluntarily by municipalities and developers. The focus of these two guideline documents is primarily the water quantity aspect of urban drainage management. Additional technical documents are currently being drafted and are expected to address the water quantity and quality aspect of urban drainage management and appropriate control technologies.

The Ontario Ministry of the Environment is also developing an urban drainage policy for existing development to protect the Province's water quality through the rigorous management of stormwater discharges and combined sewer overflows.

Pollution Control and Infrastructure

A major goal of the Ontario Ministry of the Environment's LifeLines Program is to improve and protect the quality of ground water and surface waters. The program provides financial assistance to municipalities to develop and plan for remedying existing water pollution problems, and to assess and rehabilitate the Province's water and sewer lines. Grants available under the program include: 1) assistance towards the cost of

completing pollution control planning (PCP) studies; 2) needs studies; and 3) the rehabilitation of water distribution and/or sewage collection systems.

Pollution control planning studies assist in the development of a water pollution control plan for a defined urban/rural area. Such studies outline the nature, cause and extent of pollution problems, propose alternative remedial measures and recommend an implementation program. There has been a high participation rate by municipalities in undertaking PCP studies to remediate water quality problems at urban beaches. A total of 11 PCP studies have been undertaken to date, four of these PCP studies were initiated after 1988.

A needs study provides an inventory of the existing water distribution and/or sewage collection systems, identification of the deficiencies within the systems and a plan of action for a rehabilitation program. A total of 287 needs studies have been approved under the program. Over 500 projects have been approved to rehabilitate, renovate, repair or replace existing water distribution or sewage systems as identified in the needs study.

Control of Toxic Substances

The Ontario Ministry of the Environment is currently developing the MISA (Municipal-Industrial Strategy for Abatement) Sewer Use Control Program to control indirect industrial discharges to municipal sewer systems. The proposed strategy's long term goal is to virtually eliminate toxic discharges to the sewer system. The strategy will also require industries with contaminated runoff to develop and implement a Best Management Practices (BMP) Plan. Compliance with the BMP Plan will prevent unnecessary discharges of contaminated stormwater to storm sewers. Measures taken under the Plan will address materials storage, housekeeping practices, preventative maintenance procedures, safety programs and employee training.

The MISA Sewer Use Control Program discussion paper entitled "Controlling Industrial Discharges to Sewers", which was released in September, 1988, outlined a framework for controlling industrial discharges to sewers based on five principles. These included: 1) control at source; 2) provincial discharge limits based on BAT(EA); 3) local limits; 4) municipal enforcement; and 5) public consultation.

Municipalities will be required to undertake new responsibilities for monitoring and regulating discharges to municipal sewer systems under the program. The program is intended to be self-financing.

The Ministry has initiated five demonstration projects to determine the practicality of the sewer use control program. The five municipalities participating in the demonstration are Cobourg, Gananoque, Hamilton-Wentworth, Ingersoll and Thunder Bay. The demonstration projects are funded at a 50 per cent level for program development and a 33 per cent level for capital equipment as specified under Ontario's Water and Sewage Systems Direct Grants Program.

The projects were initiated in December, 1989. All municipalities have completed the first and second phase sampling of the sewage treatment plants and residential sections of the collection system and have undertaken some form of public participation program in their communities. They have also completed the industrial waste survey, and industrial inspections at all Significant Industrial Dischargers.

An industrial waste sampling program at the inspected sites is under way. This will complete the field programs. Development of controls and limits based on the field studies and a sewer use by-law were initiated in September, 1990. Summary reports will be prepared by each of the demonstration municipalities. These will be used in the development of the Sewer Use Program Regulation.

Research

Environment Canada has ongoing research activities related to urban non-point source pollution. A new methodology for the evaluation of loadings was developed and used to produce screening estimates of toxic substances loadings from urban runoff in the Great Lakes Basin. Detailed studies focused on several of the Areas of Concern, including: the St. Marys River in Sault Ste. Marie, the St. Clair River in Sarnia, the Detroit River in Windsor, and Hamilton Harbour. Planning-level estimates of urban non-point pollution loadings were established and used in the development of pollution control strategies for the first three areas. These studies will be complemented by the ongoing investigations of urban sources of bacteriological pollution.

Studies of highway runoff pollution in a selected location have been undertaken and indicated significant loadings of heavy metals and polynuclear aromatic hydrocarbons (PAHs). The data obtained will be used to develop the predictive capability for the evaluation of highway runoff pollution.

Wetlands and their Preservation

Extensive shoreline and riverine wetlands occur in the Great Lakes Basin and along the St. Lawrence River. Wetlands play a critical role in maintaining the health and dynamics of the Great Lakes Basin Ecosystem. Hydrological benefits include flood control and shoreline stabilization. Wetlands help to protect water quality

by filtering nutrients and toxins from the surface runoff and can help prevent eutrophication. They provide critical habitat for flora and fauna, including some endangered species. As breeding grounds for fish, waterfowl and furbearers, wetlands represent a source of economic benefit. Some examples of important wetlands in the Great Lakes Basin include Walpole Island, Long Point and the mouth of the Grand River. Marshes at the mouth of the Grand River are being evaluated for possible acquisition.

Many wetlands in the Great Lakes Ecosystem have disappeared over the years through urban encroachment, land drainage, and filling. Annex 13 requires that significant wetland areas which are threatened by urban and agricultural development are identified, preserved and, where necessary, rehabilitated. Annex 7 also states that the Parties "direct particular attention to the identification and preservation of significant wetland areas in the Great Lakes Basin Ecosystem which are threatened by dredging and disposal activities".

The goal of the Ontario Ministry of Natural Resources' Wetlands Management Program is to ensure the protection of wetlands across the Province of Ontario. For expenditures under the Ontario Ministry of Natural Resources' Wetlands Management Program, please refer to *Table VI*. This program is a composite of a number of existing programs, including:

1) wetland inventory and evaluation;
2) development of a provincial Wetlands Planning Policy Statement;
3) the Conservation Lands Act;
4) wetland securing effort;
5) wetland research;
6) provision of information;
7) protection of wetlands in public ownership;
8) the North American Waterfowl Management Plan; and
9) participation in the Convention on Wetlands of International Importance especially as waterfowl habitat (the Ramsar Convention).

The following paragraphs provide an update on some of the progress which has been made under the program since 1988:

A total of 2,001 wetlands have been evaluated using the Evaluation System for Wetlands South of the Precambrian Shield. This evaluation system only applies to wetlands located in southern Ontario. The Ontario Ministry of the Environment has developed a revision for the hydrological component of the present southern wetland evaluation system and will be proposing changes in the future to strengthen that component. Other components of the existing evaluation system such as values related to fisheries and other factors are also currently being revised and updated. Using the evaluation system, wetlands are then ranked on a scale from 1 (highest value) to 7 (lowest value).

TABLE VI

Expenditures for MNR's Wetlands Management Program

	Securing of Welands	Wetlands Evaluation
FY 1988/89	$250,000	$250,000
FY 1989/90	$250,000	$300,000
TOTAL:	$500,000	$550,000

Work has begun on the development of a northern wetland evaluation system, which is to be applied in selected priority areas or on an "as needed" basis.

The provincial Wetlands Planning Policy Statement, which is being developed under Section 3 of the Planning Act by the Ministries of Municipal Affairs and Natural Resources, will require that municipalities have regard for the identification and protection of Provincially Significant wetlands in municipal Official Plans.

Provincially Significant wetlands are Class 1 and 2 wetlands. Work is currently proceeding on the final version of this policy statement which could also include Regionally Significant Class 3 wetlands under the same consideration as afforded Class 1 and 2 wetlands.

The North American Waterfowl Management Plan provides for the securing of waterfowl habitat of continental importance to migratory waterfowl. In Ontario, the plan is implemented under a wetland habitat securing program in a joint partnership with Wildlife Habitat Canada, the Canadian Wildlife Service, Ducks Unlimited Canada, the Ontario Ministry of Natural Resources, and the Nature Conservancy of Canada. The plan focuses principally on Great Lakes habitats.

Provincial wetland research has assessed organochlorine impacts on wetland wildlife such as resident waterfowl, snapping turtles and mink in several programs on degraded coastal wetlands and elsewhere. Presentation of results have been made at the International Association of Great Lakes Research (IAGLR) - 1988/89 and Society for Environmental Toxicology and Chemistry (SETAC) - 1989 conferences, and several publications are currently being completed.

Work is proceeding to complete publication of summary information on all Class 1, 2 and 3 wetlands. The second publication dealing with descriptions of these significant wetlands is anticipated in early 1991. Previous publication of this information was very well received by municipal agencies, non-governmental organizations and the general public. A strong recommendation is expected from the municipalities of Ontario to increase efforts in educating the public about the value of wetlands.

The Ramsar Convention is an international treaty which provides the framework for international cooperation for the conservation of wetland habitats. Canada was one of the original signatories to this convention and has been a major participant in designating such wetlands. Ontario and Canada have proposed several major wetlands under this convention including Long Point and the St. Clair National Area.

Environment Canada is involved in a number of monitoring and surveillance projects related to wetlands. A major initiative is the "Wetlands at Risk" project which identifies wetlands that are at risk from toxic chemical stresses from urban and agricultural sources, and studies the impacts of fluctuating Great Lakes water levels on shore zone wetlands. A background report for the project is being finalized. This work may allow development of monitoring and other recommendations on actions needed for the protection and rehabilitation of wetlands in the lower Great Lakes Basin.

Environment Canada has also undertaken monitoring activities in conjunction with the Ontario Ministry of Natural Resources to determine the presence of herbicides (atrazine and metolachlor) in wetlands associated with Rondeau Harbour and the Big Creek National Wildlife Area.

The Department of Fisheries and Oceans continues to use the *Fisheries Act* and the Policy for the Management of Fish Habitat (1986) to reduce the incremental loss of wetland habitat within the Great Lakes Basin. The Department of Fisheries and Oceans and the Ontario Ministry of Natural Resources have been working closely together for the past three years to protect wetlands that serve as fish habitat.

ANNEX 14:
Contaminated Sediment

In Accordance with Annex 14, the Parties, with the co-operation of state and provincial governments, are required to:

(i) identify the nature and extent of sediment pollution in the Great Lakes System;

(ii) undertake research and studies, including surveillance programs and evaluation of existing technology for the management of contaminated sediment;

(iii) ensure long term measures are adopted for the management of contaminated sediment; and

(iv) report to the International Joint Commission, biennially, starting in December, 1988, on the progress of implementation of Annex 14.

Activities since the *First Report of Canada* in December, 1988, include the following:

(i) **Nature and Extent of Sediment Pollution**

- Development of a standardised assessment procedure for contaminated sediment which incorporates the physical and chemical evaluation of sediments as well as an assessment of biological implications of the associated contaminants is ongoing.
- Development of criteria for the assessment of sediments based on documented concentrations of metals, organic contaminants in sediment and their impact or aquatic macroinvertebrates and fish is continuing.
- An international workshop on the development of biological guidelines for the assessment of contaminated sediments was held in January, 1991, in Cambridge, Ontario.

(ii) **Research Studies**

- Transfer of contaminants from sediment to biota model development is proceeding as planned. A preliminary model is being applied to the Bay of Quinte so as to quantify methods for uptake rates and the transfer process.
- Biologically based protocols for sediment evaluation, dependent upon *in situ* work aimed at quantification of processed and development of models to be used in establishment and refinement of sediment criteria are being developed by Canada. A working group has been formed since August, 1990, and research is continuing on schedule.
- Issuance of a call for proposals which assesses removal and treatment technologies (including the development of operational and performance standards used to evaluate the effectiveness of the equipment).
- A workshop on cleanup and remediation of contaminated sediments was held in March, 1990, in order to develop a plan of action for addressing assessment, removal and treatment of contaminated sediments.
- A workshop on the bioremediation of contaminated sediments was jointly sponsored by Canada and the U.S. in July, 1990, in order to identify applicable remedial technologies to treat contaminated sediments in Areas of Concern.
- A contract has been awarded to ELI ECOLOGIC to undertake pilot scale demonstration of its proprietary thermochemical reduction process for organic compounds in sediments. Sediments from Hamilton Harbour and Sheboygan are being treated.
- Site visits and audits of the Sydney Tar Ponds cleanup have been undertaken. A two day demonstration of innovative sediment pumping technology was undertaken with a view to demonstrating this equipment in the Great Lakes Basin. The Superburn incineration technology used for treating the sediments was also evaluated.
- Meetings have taken place with industry and vendors of dredging equipment with the aim of encouraging proposals of a co-operative nature for the demonstration of removal and treatment technologies.
- Linkages with U. S. EPA ARC Program have occurred for the purpose of undertaking joint demonstrations of removal and treatment technologies.
- Site visits to U.S. Superfund sites (Sheboygan, WI and Larne, OH) in order to witness and evaluate removal and treatment methods currently in use.

(iii) **Long Term Measures**

- In order to ensure the adoption of measures for the management of contaminated sediment through the construction and long term maintenance of disposal facilities, Canada and Ontario are formulating guidelines for the controlled placement of dredge material.
- A report has been completed which evaluates the state of all confined disposal facilities (CDF) on the Canadian side of the Great Lakes. Recommendations for management of the CDFs have been prepared. Field tests using plant and animal bioassays are ongoing to determine the long term environmental effects.

National Water Research Institute Activities

Research at the National Water Research Institute (NWRI) on contaminated sediments in the Great Lakes continued to provide a guide to the development of Remedial Action Plans, to evaluate the impact of polluted sediments on the Great Lakes system, and to contribute to the development of Lakewide Management Plans.

Methods for the biological assessment of contaminated sediments have been developed and tested in co-operation with U.S. government agencies and universities, as well as the Ontario Ministry of the Environment through the COA Polluted Sediment Committee. Test species included oligochaetes, a widely distributed and important component of the Great Lakes benthic community, and *Photobacterium sp.*.

NWRI staff members took part in the preparation of the IJC documents, *Procedures for the Assessment of Contaminated Sediment Problems in the Great Lakes and Options for the Remediation of Contaminated Sediments in the Great Lakes*. These documents were prepared as guidelines for RAP Teams for the remediation of contaminated sediments. An overview of sediment treatment technologies was summarized and presented at the World Dredging Congress. In addition, NWRI actively participated in the organization and program presentations of the "Technology Transfer Symposium for the Remediation of Contaminated Sediments in the Great Lakes Basin" sponsored by the IJC in October, 1988. Proceedings of the symposium were published in 1990.

Development of a model for the evaluation of contaminated sediment/water interactions has started. Data gathering for verification of the model included the identification of sediment pollution; transport studies of sediment-associated contaminants by resuspension and redeposition in Lakes Erie and Ontario; transport of contaminants in the nepheloid layer in Lake Ontario, migration of contaminants through sediment pore water; and the biological assessment of contaminated sediments at selected areas in the Great Lakes.

A comprehensive review of the methodologies used for quantifying and evaluating the transfer of contaminants and nutrients to and from bottom sediments was compiled in 1989. As a result, several recommendations were made for the development of a standard set of methods for assessing chemical and biological exchange between sediments and water which would have application in the Great Lakes.

In response to the information requirements related to the management of dredge spoil disposal, scientists at the institute have completed a series of studies on contaminant loss and bioaccumulation associated with confined disposal facilities (CDFs). Ten sites were examined; one in Lake Superior, two in the St. Clair River and Lake St. Clair, two in Lake Erie and five in Lake Ontario. The studies showed that some metals and organic contaminants are being transferred to the vegetative cover and resident invertebrates, birds and mammals. The results further indicate that the amounts and rates of transfer of contaminants are affected by the depth of "clean soil" cap and vegetative cover. It is evident that careful management of these facilities will be required to reduce or eliminate any long term environmental effects.

Agriculture Canada

Research is planned to develop techniques to monitor the biological fate and pathways of agricultural chemicals in dredged soil materials. Specifically, the studies will establish the occurrence of toxic agricultural chemicals in sediments of Great Lakes harbours, bays, etc. It is anticipated that the work will be done on one or more of the RAP study areas where rural non-point source pollution issues have been raised.

Department of Fisheries & Oceans Activities

The Department of Fisheries & Oceans has been actively engaged in sediment toxicity research for a considerable period of time. The department's Great Lakes Laboratory for Fisheries & Aquatic Sciences has participated in several projects with various Areas of Concern such as Metro Toronto and Region, the Upper Great Lakes Connecting Channels, and the St. Lawrence River. Fisheries & Oceans has attempted to focus on specific issues dealing with the management of contaminated sediments. Therefore, the department exerted a concentrated effort on the Great Lakes Areas of Concern to facilitate the development of Remedial Action Plans. The following aspects of contaminated sediments are

under investigation in the Great Lakes Laboratory for Fisheries & Oceans:

A. Multi-trophic battery of tests (structural/functional): to develop and standardize a suite of structural and functional tests to assess the impact of contaminants.

B. Bottom fauna surveys: to conduct benthic surveys to measure recovery of contaminated sites based on indicator species.

C. Chemical dynamics: evaluation and standardization of various procedures of sediment handling such as collection (with various samplers), preservation, storage, processing and analytical methodology. Such information is lacking at the present time.

Ontario Ministry of the Environment

The Ontario Ministry of the Environment continues to support sediment-related efforts in relation to Areas of Concern and research on the effects of contaminants in sediments on aquatic organisms and water quality. The province has developed a draft set of biologically-based sediment quality guidelines. The guidelines provide a tiered approach to sediment assessment and offer practical decision-making options in dealing with contaminated sediments. The province has also prepared a "Laboratory Sediment Biological Testing Protocol" for testing contaminated sediment. The protocol uses a tiered approach based on mayfly nymph, midge larvae and juvenile fathead minnows to measure lethality, sublethal growth effects and bioaccumulation.

ANNEX 15:
Airborne Toxic Substances

Many toxic substances are carried into the Great Lakes by the atmosphere. They settle out on land and are washed into the Lakes or they may enter the Lakes directly from the atmosphere as gases/particles or in precipitation. Annex 15 of the Protocol calls for the creation of a surveillance network to acquire accurate information on the nature and amount of toxic substances entering the Lakes from the atmosphere, as well as the identification and control of emission sources. In accordance with Annex 15, the following work has been undertaken, since the *First Report of Canada* was produced, for the purpose of reducing atmospheric deposition of toxic substances into the Great Lakes Basin Ecosystem.

1. Research - is being conducted to refine monitoring techniques for toxic substances and to determine pathways, fate and effects of airborne toxic substances.

2. Surveillance and Monitoring - the Implementation Plan for the Integrated Atmospheric Deposition Network (IADN) was signed by the Parties in June, 1990. This Network is being established, along with other atmospheric monitoring programs, to identify toxic substances present and to estimate their loadings to the Great Lakes Basin.

3. Pollution Control Measures - are being developed, adopted and implemented for cases when atmospheric releases of toxic substances contribute significantly to pollution of the Great Lakes Basin.

Research

A number of agencies and departments are contributing to the Annex 15 Research effort. These include:

Agriculture Canada

In addition to participating on the COA Airborne Toxics Committee, the following research projects were carried out in order to develop measuring systems of agrochemicals fluxes:

- Theoretical validation of the Relaxed Eddy Accumulation Technique (REAT) was completed for aircraft-based approach (MacPherson and Desjardins, 1990).
- Prototype systems based on REAT were developed:

  - one on an aircraft: tested with CO_2 and CH_4 flux measurements;

  - one on ground: tested with measurements of volatilization of two herbicides (triallate and trifluralin) Majewski et al., 1990)

Other ongoing research projects include:

- simulation of the REAT with tower-based data, to help in the design of a measuring system;
- experiments on an improved ground-based system were carried out to determine CO2 fluxes; part of the findings will be transferred to the aircraft system;
- development of an automatic agrochemicals accumulator is ongoing; and
- different options to capture gas samples for subsequent analysis are being investigated.

Environment Canada

Atmospheric Environment Service

The establishment of an integrated atmospheric deposition network is specified under Annex 15 of the GLWQA. A three phase programme (two years each) designed to accomplish this, has been approved by the United States and Canada and is on schedule. A "master" or research station is operational at Point Petre (Lake Ontario), a second site (operational in 1991) has been selected, and several "Satellite" or routine stations have been tentatively identified (operational in 1992). Preliminary rainfall data from 1989 have been analyzed and a report is in preparation. In addition, an all-weather sampler has been tested and a report on its feasibility is in preparation.

Determination of the mass transfer coefficients for vapour phase contaminant movement at the air-water interface is also identified under Annex 15. A gas transfer flume has been constructed, consisting of a 31 m recirculating flume interfaced with an enclosed wind tunnel. Conditions simulating 0-80 km/h winds over water can be achieved; instrumentation for characterizing wave motion and turbulence has been installed. Some delay has been experienced due to the loss of key personnel. Current results using chlorobenzene in the

flume demonstrated good reproducibility for mass transfer coefficients in accord with theoretical values.

Research is ongoing on a number of topics:

- ***The Air/Water or Air/Soil Boundary***

  Research is under way to intercompare techniques (sparger and flux chamber) applicable to investigations of air/water exchange processes. Acquisition and laboratory testing of an instrumental system for the determination of the magnitude and direction of gas transfer at the air/water interface is ongoing.

- ***Modelling***

  The atmospheric transport and deposition of toxic chemicals to the Great Lakes Basin is being modelled, with particular emphasis on the parameterization of air/sea and air/soil exchange processes. A model to predict volatilization of toxic material from vegetated soil has been developed. This model is a key to understanding the cycling of persistent toxic chemicals within the ecosystem. The model has been used to simulate the air/soil processes for some pesticides; 2-4-D, lindane, DDT and chlordane for a nine month period.

  Also, a Lagrangian model has been applied to investigate regional scale transport. A study of toxaphene clearly illustrates that sources outside North America may impact on the Great Lakes Region.

- ***Specific Toxics***

  Three GAP samplers were set up at the Point Petre Master Station in November, 1988, and have been used since then to collect atmospheric samples from which the gas and particle partition, as well as the total mass loading of -HCS, -HCH, HCB and numerous PCBs, were determined at that site. Improved sampling and analytical methodologies for mercury in the atmosphere are being developed and evaluated.

  The deposition of metals and common ions in the Great Lakes Basin is being studied through the use of precipitation chemistry data.

- ***Toxics Laboratory***

  Analysis of air and precipitation samples taken by the Environment Canada component of the Point Petre Master Station (with the exception of the precipitation samples taken by the Inland Waters Directorate which are being analysed by the National Water Quality Laboratory) are being carried out in a newly established toxics laboratory in Downsview, Ontario. The work has focused on implementation and consolidation of the analytical methodologies for the Annex 15 target species. Acquisition of state-of-the-art equipment to allow the quickest, most efficient and most accurate processing of the data is under way. Techniques to allow routine measurement of ultra-trace levels of the toxics to be sampled by the Integrated Atmospheric Deposition Network are being researched.

  Overall, the full sample cleanup/analytical procedure has been shown to perform satisfactorily for test mixtures of PAHs, with good recoveries and sensitivities. Detection limits for the measurement method for the 19 target PAHs are 100 pg for all components. For some species, such as anthracene, levels down to 1 pg can be detected.

- ***Organochlorine Sources***

  As a result of the PCB/OC study at Egbert, Ontario, and previous publications by AES scientists (Volner et al, Lane et al.) it is apparent that the transport of PCBs and OCs from various southern North American locations is probable. Due to the temporary presence of a key scientist in the U.S., sampling at "locations of opportunity" is being undertaken to ascertain concentrations closer to suspected source regions. These locations will be Boulder, CO, east of Los Angeles, CA, and Hampton, VA, in the U.S. In addition, a cooperative project with the University of the West Indies in Jamaica is being examined as a possible sampling site for a Caribbean regional signature.

Conservation and Protection

Environmental Protection has been developing and implementing technologies to measure and control air pollutants. These monitoring technologies allow the identification and quantification of more compounds at very low detection levels. *Table VII* details the Environmental Protection ambient air toxics monitoring protocol.

Development and refinement of Reference Methods are also carried on to determine compliance with regulations on atmospheric releases of toxic substances.

Inland Waters Directorate

A six station network is in operation in the Great Lakes Basin to measure concentrations of organochlorine pesticides, total PCBs, chlorobenzenes and PAHs in wet precipitation. Since 1986, sites at Sibley (Lake Superior), South Baymouth (Lake Huron), Pelee Island (Lake Erie) and Wolfe Island (Lake Ontario) have been

TABLE VII

Ambient Air Toxics Monitoring Protocol (Environmental Protection)

Compound	Number of Species or Isomer Groups Measured	Target Detection Level
PCDD/PCDF	10	0.05 - 0.20 pg/m^3
PCB	10	0.04 - 0.08 ng/m^3
Chlorobenzene	4	0.02 ng/m^3
Chlorophenols	4	0.06 - 0.12 ng/m^3
PAH	28	0.02 - 0.05 ng/m^3
Elements and Ions	42	1-50 ng/m^3
VOCs	90	0.1 µg/m^3

operating year-round; in 1988, a sampler was installed at the Canadian Master Station in Point Petre. This past year, the network was expanded to include a site at Walpole Island. With incorporation of the forthcoming recommendations from the Quality Assurance/Quality Control Work Group, it is anticipated that these sites may become part of the Satellite Station Network in the Great Lakes Basin.

National Water Research Institute

NWRI is carrying out research in a number of areas:

- Gas transfer across the air/water interface.

  Determination of mass transfer coefficients for vapour phase contaminant movement at the air/water interface is indicated under Annex 15 2(i). A gas transfer flume has been constructed consisting of a 31 m recirculating flume interfaced with an enclosed wind tunnel.

- Atmospheric input of metals.

  Trace metals are among the identified atmospheric pollutants entering the Great Lakes. A major failing in current analytical methodology for metals has been contamination at trace levels. A new facility has been constructed to provide "clean" conditions for processing such samples. Complimentary collection and preservation methodology is to be completed in fiscal year 1990/91. This technology is to be applied to surface water samples, rain and airborne dryfall, and other atmospheric related samples to respond to Annex 15, 2(a), 2(c), (i) and 3 (c), (i & ii) as well as to confirm results from the Integrated Atmospheric Deposition Network.

- Modelling of atmospheric loadings.

  Annex 15, 2 (c)(i) specifically requires the development of models for determining the significance of atmospheric loadings relative to other pathways. Determinations of tributary and outlet ("dissolved" and suspended), *in situ* ("dissolved", suspended and surficial sediments) as well as atmospheric (vapour, particulate and rainfall) burdens/loadings of lake systems have been done. These provide a basis for validating a model for persistent organic chemicals in lakes on a seasonal basis. Sampling and analyses are complete for a small lake in the Turkey Lake (Lake Superior) watershed and sampling will be complete for Lake Ontario during fiscal year 1990/91. Physical models for both systems are available and are being integrated with fugacity type distribution models. Model development is nearly complete for Little Turkey Lake; similar activity for Lake Ontario awaits refinement and testing of the former.

- Dynamics of atmospheric contaminants in lakes.

  A general hypothesis about the linkages between the trophic status of lakes and contaminant dynamics (Annex 15 2(b)) is being studied. Thirty-three oligotrophic-mesotrophic lakes in south-central Ontario are being investigated. Persistent organic chemicals enter these 33 lakes exclusively via the atmosphere. Present investigations show that the major factor determining concentrations in zooplankton is an inverse relationship with spring total phosphorus concentrations. Concentrations higher in the food chain appear to be related to the length of the particular food chain and the presence of planktivores in the chain.

National Health and Welfare

As a result of the reduction in the person-year allotment for the Great Lakes Health Effects Program, the Department of National Health and Welfare has not undertaken research projects specifically targeted to Annex 15. However, there is active involvement in several related projects which will provide health information on air toxics in the Great Lakes Basin. Animal inhalation studies to be completed in the fiscal year 1991/92 will provide toxicological data following exposure to ambient concentrations of ozone. A multi-year, joint Canadian/U.S. study is being conducted to exam-

ine the effects of acid aerosols on the health of school-aged children. As well, a considerable effort is being directed toward preparing toxicological profiles of regional air pollutants for the Detroit, Windsor, Port Huron, Sarnia Air Pollution Advisory Board to the IJC. In anticipation of additional person-year allotments in the next fiscal year, Health and Welfare representatives continue to participate on the COA Airborne Toxics Committee to discuss ongoing and future research plans for Annex 15.

Ontario Ministry of the Environment

- ***Health Effects***

  Health effects work on persistent toxic substances is ongoing at the Air Resources and Hazardous Contaminants Co-ordination Branches of the Ministry. The potential effects of airborne toxics on the terrestrial portion of the Great Lakes Ecosystem are also being investigated. These are long term programs.

- ***Modelling***

  The Ministry has modified its version of the Acid Deposition and Oxidants Model (ADOM) to address the long-range transport of toxics. In co-operation with AES, the model is currently being applied to the transport and deposition of mercury. As part of an ongoing effort, the Ontario Ministry of the Environment has also refined its emission inventory for persistent organic toxics, which includes the provinces and states bordering on the Great Lakes.

- ***Sampling techniques***

  Work is nearing completion on the development of a sampling technique for dioxins and furans in precipitation. Other Ontario Ministry of the Environment techniques for monitoring toxics in air and precipitation are being evaluated at the Point Petre Master Station.

Surveillance and Monitoring

The major milestone that has been achieved since the last report has been the signing of the Implementation Plan for the Integrated Atmospheric Deposition Network (IADN) by the Parties on June 14, 1990. The major effort in monitoring has been the establishment of a framework for a network of master/satellite stations to cover the Great Lakes Basin. Specified under Annex 15 (3) and (4) of the GLWQA, the Network implementation is on schedule and involves a three phase program, with two years for each phase.

The Point Petre Master Station of the Integrated Atmospheric Deposition Network has been in operation since November, 1988. Three reports of the meteorological data from the site have been prepared. Analyses of the organic air samples from the site are being carried out under the Toxics Laboratory project. Laboratory analysis of the first year of trace metals data has been accomplished and the data is being analysed. The Ontario AES Regional Scientific Services Unit is co-operating on this part of the Annex 15 activities.

The installation of a second Canadian Master Station on Lake Huron is scheduled for 1991. During this fiscal year, locations for the site and access to the site are being examined. Air sampling equipment for the station has been or is being purchased during this fiscal year. The hope is that the station will be constructed and operational by April, 1991. The second site is due to be operational in 1992.

During the completion of a related project, sampling has been carried out at the Centre for Atmospheric Research Experiments at Egbert, Ontario, since July, 1988, in order to:

- obtain the annual cycle of organochlorine air concentrations (important for determining the cycle of deposition to the Great Lakes);
- test the operation of a satellite facility.

This work is ongoing and publication of the first results of the study is in progress (see Hoff, Muir and Grift). These results have shown that air concentrations of PCBs and OCs in the Great Lakes have a markedly peaked annual cycle, that they can be parameterized by a relatively simple formula, and that the time series data can be used to identify source regions for these chemicals. One such region for toxaphene, DDT and lindane appears to be the southeastern U.S.

As a second text of a satellite facility, a station has been established at ELA Kenora under the operation of Department of Fisheries and Oceans, Winnipeg. This station will operate at this location well upwind of the Great Lakes for the summer and fall of 1990.

Several Satellite sites have been tentatively identified and are due to become operational in 1992.

The Inland Waters Directorate has operated (since 1979) a sixteen station network measuring conventional chemical constituents (nutrients, major ions and metals) in wet precipitation near the Canadian Great Lakes. Results from the network are routinely reported annually to the Water Quality Board of IJC to provide loading estimates for mass balance calculations.

Preliminary rainfall data from 1989 is developed by NWRI and a report is in preparation. An all-weather

sampler has been tested and a report on its feasibility is in preparation.

Selected vegetation is being investigated by NWRI for monitoring trends of established contaminants (Annex 15, 1 and 3 (b) & (c)). Shoreline-inland transects with moss, lichens, forest litter and other atmospheric-related sample types have been completed in the Lake Superior area; in related (unsupported by Great Lakes Water Quality Program) studies, pine needles have been established as suitable monitors for atmospheric contamination in the vapour state.

The Ontario Ministry of the Environment established five toxics deposition monitoring sites in the Great Lakes Basin several years ago, and monitoring at these sites is ongoing. Depending on the outcome of sampling technique assessments at the Point Petre Master Station, these sites may become part of the Satellite Station Network in the Great Lakes Basin. The substances monitored included PCBs, PAHs and a number of organochlorine pesticides, as well as dioxins/furans at some sites. Quality Assurance/Quality Control procedures have been established for the provincial network.

The Ontario Ministry of the Environment is also continuing to monitor acid-related contaminants and trace metals, including lead and cadmium, at a number of sites in the Great Lakes Basin, under a full Quality Assurance/Quality Control program.

The Ontario Ministry of the Environment continues to participate on the working groups to address various components of the Integrated Atmospheric Deposition Network.

Monitoring for organic compounds (volatile and semi-volatile) is currently being carried out by Environmental Protection and River Road Environmental Technology Centre at several sites in Ontario.

The three EP toxic air monitoring stations (two located in Windsor, one on Walpole Island) are equipped with specialized instruments for measuring ambient air concentrations of PAH, PCB, CP, CB, PCDD, PCDF, inhalable particulate matter and VOC. Sarnia, Toronto and Hamilton are also the sites of measurement of some ambient toxic air pollutants. The Walpole Island Station represents background conditions because it is located in a remote rural area. The Walpole Island station is also equipped with a meteorological station and is part of the IWD network for persistent organic contaminants in wet precipitation in the Great Lakes. These conditions make the Walpole Island station a good candidate to become one of the first satellite stations of the IADN. Since the establishment of the Environmental Protection Toxic Air Monitoring Network (July, 1987) four data reports have been published (April, 1988; December, 1988; May, 1989; and June, 1990). Most of the compounds detected at the Windsor monitoring site are measured in quantities greater than the minimum detection level. PCDD and PCDF are detected at both the Windsor and Walpole Island site, but at levels well below the Canadian Council of Ministers of the Environment ambient air guideline of 5 pg/m^3 of 2,3,7,8-TCDD equivalents. PAH levels detected in Windsor are found to be comparable to those in other Canadian urban centres. PCBs are detected at very low levels in Windsor, significantly lower than Ontario's annual ambient air quality guidelines of 35 ng/m^3. At the Walpole Island site, PCB levels are below or near detection levels for all samples.

Environment Canada's Environmental Protection Section - Ontario Region has a significant database of ambient air measurements which requires analysis and interpretation. Environment Canada is currently negotiating the terms of a joint project with the Source Apportionment Research Branch of the U.S. EPA's Atmospheric Research and Exposure Assessment Laboratory for the analysis and interpretation of these data. This involves a five-year project, the goal of which is to determine, using Chemical Mass Balance (CMB) receptor modelling techniques on the PM10 (particulate matter < 10 um) and VOC data, and possibly on the other toxic organic data, the anthropogenic and biogenic sources of those air pollutants in the Windsor area. To conduct the CMB modelling work, it will be necessary to assemble meteorological data and emission source inventory data for the Windsor/Detroit area. Existing data will be used to develop a list of all major point and area sources of toxic organic compounds in the Windsor/Detroit area, with emission and species profiles, source locations and emission rates, as well as meteorological data from several sites in the area. A contract will be issued by EP-OR for the delivery of this work. The project is expected to commence before the end of 1990.

Pollution Control Measures

Ontario has launched a major program to control the atmospheric emissions of pollutants, including many persistent toxics which impact on the Great Lakes Ecosystem. This program, called the Clean Air Program (CAP), involves a number of reforms to the Air Pollution General Regulation (Regulation 308), most notably the replacement of dispersion to deal with air pollutants by the control of emissions at the source (to the degree appropriate for the contaminant under consideration). The reforms were launched partly in recognition of the fact that some chemicals persist in the environment much longer and travel further than was widely believed, and can subsequently enter the food chain.

A federal/provincial ad-hoc working group is being established to address pollution control measures, and

to develop strategies necessary for reducing toxic emissions into the Great Lakes Ecosystem. A pollution control program will be developed taking into consideration the Canadian Environmental Protection Act (CEPA) activities and the provincial Clean Air Program.

The Canadian Environmental Protection Act (CEPA) that was promulgated in June, 1988, requires industries and government to come to grips with the thousands of substances and hundreds of effluent streams and emissions generated by industrial activities and other operations. This involves identifying substances that may be toxic, assessing them to determine the hazard and for substances that are found to be toxic, establishing and applying controls throughout their life cycle to prevent harm to human health and the environment. The CEPA Priority Substances List (PSL), which drives CEPA's assessment program was created to focus the federal government's priorities for activities that release toxic substances. Several substances on the PSL are also of a serious concern for the Great Lakes (e.g., chlorinated organic compounds, PAH, chromium). Once a substance is declared toxic, controls are developed and implemented (eg: secondary lead smelter release regulations, chlor-alkali mercury release regulations). EP-OR has established a comprehensive compliance and enforcement program for the CEPA regulated industries.

The Canadian Council of Ministers of the Environment (CCME) requested in October, 1988, that a management plan be developed for the control of nitrogen oxides (NOx) and volatile organic compounds (VOCs). The plan is being delivered to CCME this fall (1990). Phase I of the plan is designed to put in place a strong prevention program supplemented by a comprehensive set of remedial actions in the areas of Canada most affected by ground level ozone, including the lower Great Lakes (Windsor - Quebec City corridor).

Research has demonstrated that the atmospheric deposition of agricultural chemicals on the Great Lakes can be significant. However, little information is available on the potential for atmospheric transport and deposition for common agricultural pesticides used in the Basin. Studies have been initiated to establish the magnitude of transport and deposition of selected pesticides via the airborne dust and vapour pathways. The studies should yield regional estimates of atmospheric transfer of agricultural pesticides.

ANNEX 16:
Pollution from Contaminated Groundwater

Contaminated groundwater is affecting the boundary waters of the Great Lakes. The location and extent of this contamination is the subject of ongoing investigation and study by several agencies within the governments of Canada and Ontario. This total effort is co-ordinated and reported on by the Groundwater Committee of the Review Board under the Canada-Ontario Agreement Respecting Great Lakes Water Quality (COA).

The Groundwater Committee is charged to:

A) ensure the identification of existing and potential sources of contaminated groundwater affecting the Great Lakes;

B) co-ordinate the mapping of hydrogeological conditions in the vicinity of existing and potential sources of contaminated groundwater;

C) facilitate the development of standard approaches and internationally agreed procedures for sampling and analysis of contaminated groundwater; and

D) monitor the control of sources of contamination of groundwater and the contaminated groundwater itself, when the problem has been identified.

This report of the Groundwater Committee documents the activity under Annex 16 since the First Parties Report of 1988.

Federal Programs

Federal programs related to contaminated groundwater are directed at increased understanding of hydrogeological process through research, and the development of national inventories of the resource.

Great Lakes Action Plan

The 50 million dollar "Preservation Program" component of the federal government's Great Lakes Action Plan provides operational resources, beginning in 1989 and extending for five years, to address the new requirements of the 1987 Protocol. A significant portion of these resources is being directed at groundwater issues.

Research initiatives supported by this fund are currently running at $900,000 per year and include studies of the microbiological enhanced and standard methods of groundwater remediation, an investigation of contaminant transport processes in fractured rock, and a study of contamination in the freshwater aquifer at Sarnia, Ontario, by natural causes.

National Water Research Institute Activities

During the period 1988 to 1990, research into the factors influencing the migration of groundwater contamination at Niagara Falls continued. During this time, a regional study of groundwater flow in the Niagara Falls area was completed. The results of the study show that there are primarily two groundwater flow regimes in Niagara Falls, one at shallow depth confined to the Lockport and Guelph Dolostones, and a second at great depth in the Cataract Group of shales and sandstones. The upper flow regime is characterized by active groundwater flow in regionally extensive sheeting fractures. Conversely, groundwater flow in the low flow regime is virtually non-existent with little groundwater movement in recent geological history. The water quality in both regimes is highly variable although the water in the upper regime generally has fewer dissolved constituents than that in the lower regime. Recent work is focused on developing new methods to investigate the hydraulic and contaminant transport properties of large scale sheeting fractures. This work has been conducted with the cooperation of the U.S. Geological Survey using several boreholes drilled by the USGS in Niagara Falls, NY. The results of the study show that standard methods of testing usually employed to determine the permeability of fractured rock will lead to an incorrect interpretation of the distribution of fractures in the type of bedrock common in Niagara Falls. In addition, the use of the standard method failed to give an accurate determination of the permeability of the bulk rock matrix. Knowledge of the matrix permeability is crucial in formulating accurate predictions of contaminant migration.

During the same period, groundwater investigations continued in the Sarnia, Ontario region. The objective of the study is to assess the possible impact of the deep well disposal of industrial wastes on a local aquifer. A monitoring well network of 29 piezometers was installed in the Sarnia area adjacent to the St. Clair River. Numerous samples of groundwater were obtained from this network and from a nearby deep monitoring well for geochemical analysis. Many of the volatile organics observed to be present in the deep well

are not detected in the shallow network. It is concluded that the migration of contaminants from depth towards the shallow aquifer is not widespread. Furthermore, the localized presence of chloride contamination observed in the shallow aquifer is likely due to the upwelling of deeper chloride-rich formation water. One of the difficulties encountered in this study is related to the differentiation between chemicals of natural and anthropogenic origin. A new multivariate plotting technique was developed to address this issue. The method was employed with some success to fingerprint fluid from the disposal well and natural formation waters in the Sarnia area.

Agriculture Canada

To address the question of the potential for pollution of rural groundwater; studies have been initiated to track pesticide movement from the soil surface to shallow groundwater and subsurface agricultural tile drains in conventional and conservation cropping systems. The study results will be used in pesticide transport models to determine the potential migration rates of these chemicals to subsurface water supplies.

Federal/Provincial Programs

In fulfilment of the 1989 Action Plan adopted by the COA Groundwater Subcommittee, the following was accomplished since 1988:

Continuation of Monitoring of the "Fresh Water Aquifer" and Waste Disposal Zone at Sarnia

A consultant was retained to undertake a hydrogeological assessment of groundwater flow and potential contamination beneath the "Chemical Valley" - a complex of petrochemical industries and oil refineries immediately south of Sarnia. The objectives of the assessment are to investigate:

1) the impact of deep well disposal practices, on the shallow Fresh water aquifer;

2) the seepage discharge of the Fresh water aquifer to the St. Clair River; and

3) the hydraulic relationship between the disposal zone, the Fresh water aquifer and the St. Clair River.

Two preliminary reports on this hydrogeological assessment have been completed and a final report is in preparation.

Hydrogeological Investigation at Sault Ste. Marie

A consultant was retained to assess the presence of toxic contaminants in groundwater seepage and surface runoff associated with the slag disposal site operated by Algoma Steel Corporation Ltd., in Sault Ste. Marie.

The study involves the determination of direction, quality and quantity of leachate migration from the slag site and the assessment of the impacts of this leachate migration on ground and surface waters. A final report on the investigation is under preparation.

IJC Workshop on Groundwater Contamination in the Great Lakes Basin

The COA Groundwater Subcommittee co-sponsored the above workshop which was held at the University of Waterloo, Waterloo, Ontario, on October 24th-25th, 1989.

National Contaminated Sites Clean-up Program

In October, 1989, the Canadian Council of Ministers of the Environment (CCME) established a new five year, $250 million National Contaminated Sites Clean-Up Program (NCSCP) to ensure the cleanup of contaminated sites throughout Canada. Cleanup of contaminated sites is based on the "polluter pays" principle. There are, however, contaminated sites where neither those responsible for the contamination nor the owner of the property where the contamination originated are able to pay or are willing to pay within the time frame specified. For the cleanup of these high-risk "orphan sites", the CCME's program is based on a 50-50 federal-provincial cost-sharing formula. Attempts at recovering costs will be made at those sites where the polluter is at this time unwilling to pay. This program will provide $200 million over the next five years for cleanup activities and $50 million to support decontamination technology development and demonstration, both to be shared equally by the parties on a per capita basis.

The program will enable immediate action to be taken where the responsible party is unknown, cannot be identified or located, is insolvent, or is unwilling to implement a cleanup program in a timely manner. It deals with sites where contamination poses an existing or imminent threat to human health or the environment. There are an estimated 1000 high risk contaminated sites in Canada of which an estimated 50 are orphan sites.

The Department of National Health and Welfare is assisting with the assessment of health risks posed by those sites, the determination of health-based soil quality

guidelines and methods to assess and classify sites according to possible health risks.

The Contaminated Sites program is based on the following principles:

- provinces will have necessary laws, regulations and programs in place to ensure cleanup of all high risk contaminated land sites where the responsible party can be held accountable consistent with the "polluter pays" principle;
- common site assessment, ranking, cleanup criteria and guidelines will be used to deal with orphan sites;
- governments will clean up sites where they are the responsible polluter; and
- each of the provinces and territories will have access to the federal portion of the program funding based on a per capita formula.

The Government of Canada and the Province of Ontario are negotiating the terms of their agreement and identifying candidate sites.

Since many of the sites addressed by this program are in the Great Lakes Basin, it will have a significant impact on the subject of this Annex.

International Consultation

Canada/United States consultation is required to develop the standard approaches and internationally agreed procedures for sampling and analysis of contaminated groundwater, as stated in paragraph (iii) of Annex 16. The University of Waterloo, a world renowned centre for hydrologic research, has been contacted with regard to providing the technical expertise for participation in this international consultation process. The Waterloo Centre for Groundwater Research is prepared to provide two technical experts, under contract to Environment Canada, for this purpose.

Provincial Programs

The provincial groundwater programs are directed at the protection of this resource for its own sake. It follows, nonetheless, that programs to protect or remediate the resource, ultimately protect the Great Lakes from contamination by this source. The provincial programs, as would be expected, are province-wide and not focused on the Great Lakes per se. This ongoing program was described in detail in the 1988 Report.

The Groundwater Committee of COA must provide the Agreement focus and identify those contaminated groundwater resources that are existing or potential sources of contamination to the Great Lakes.

ANNEX 17:
Research and Development

Annex 17 delineates research needs to support the achievement of the goals of the GLWQA, in accordance with the provisions of Annexes 1, 2, and 11-16.

The federal government maintains research programs to further the understanding of fundamental processes operating in the Great Lakes Basin Ecosystem and to ensure that this scientific information can be driven to clean up, protect and preserve the aquatic resources. Recent emphasis has been focused on the sources, pathways, fate and effects of pollutants directly released to the system or indirectly introduced via the atmosphere. These research activities have been driven to a large extent by the needs of the agencies fulfilling the objectives of the Annexes of the Revised GLWQA. Since the last report, much fundamental research has been carried out during site- specific studies in the Areas of Concern, under both Annex 2 and 14. Research fostered by the needs of Annexes 13, 15, and 16 are being further developed and enhanced since the new funding under the Great Lakes Action Plan (GLAP) became available in 1990. Research progress in these areas is described in each Annex chapter.

Great Lakes University Research Fund

In an effort to encourage partnerships and multidisciplinary ecosystem research, the Government of Canada has allocated part of the $125 million of the Great Lakes Action Plan to the Great Lakes University Research Fund (GLURF). GLURF, developed in partnership with the Natural Sciences and Engineering Research Council (NSERC), is a $1 million a year fund.

GLURF is a commitment to the greater scientific community working on Great Lakes issues. Such a commitment also addresses the science aspects and research needs as defined in the Great Lakes Water Quality Agreement. The fund will support university-based studies aimed at a wide range of Great Lakes environmental concerns. This four-year program will be administered by Environment Canada's National Water Research Institute in Burlington, Ontario.

Field of Research

Research proposals which include field projects conducted in the lakes, rivers, tributary basins and ground waters of the Great Lakes basin are desirable. Projects which will improve the understanding of the critical physical, chemical and biological processes affecting the ecosystem's response to contaminant stress and atmospheric change are especially encouraged. In addition, research proposals on restoration and remediation technologies and on socio-economic conditions essential for sustainable development are to be considered.

The following fields of research are considered for support through GLURF:

a) Research on the sources, pathways, fate and effects of pollutants in the Great Lakes Basin Ecosystem, specifically:

- Quantification of the mass balances for toxic chemicals budgets of the Great Lakes.
- Determination of the mass transfer of pollutants between water, sediments, air, land and biota, and the processes controlling the transfer of pollutants across interfaces between these components.
- Research on the effects of toxic chemicals on ecosystem functioning and evolution in the Great Lakes.
- Development and validation of methods to assess the effect of toxic chemicals on the health of aquatic ecosystems in the Great Lakes Basin.
- Development of innovative methods to conduct surveillance and monitoring in support of the objectives of the Great Lakes Water Quality Agreement.
- Development of innovative analytical methods for identifying and quantifying toxic chemicals in the Great Lakes and appropriate quality assurance research.
- Modelling the pathways, fate and effect of contaminants in the Great Lakes.

b) Research on the response of the Great Lakes Basin Ecosystem to stresses other than pollutants, specifically:

- Impacts from the introduction of new species and from habitat alteration.
- Hydrological, limnological and ecosystem responses to climate change.

c) Research on restoration and remediation technologies in support of the Great Lakes Water Quality Agreement, specifically:

- Innovative *in situ* remediation techniques for contaminated sediments.
- Restoration techniques for toxic chemical contamination of ground waters, in particular from dense non-aqueous phase liquids (DNAPL).
- Innovative remediation techniques to control contamination in urban runoff.
- New technologies for waste management and control of toxic chemical discharges.

d) Natural sciences and socio-economic research in support of policies directed at improving the sustainability of the Great Lakes Basin Ecosystem, specifically:

- Methods to assess the impact of land-use on management strategies for toxic chemicals in lakes and rivers of the Great Lakes Basin.
- Social and economic consequences of toxic chemical abatement regulations and analysis of strategies to reduce industrial, municipal, and agricultural use of water in the Great Lakes Basin.
- Development of knowledge engineering approaches (artificial intelligence and expert systems) to assist in the management of the Great Lakes Basin ecosystem, including methods for integration and evaluation of Great Lakes data bases.

Review Procedures and Selection Criteria

Applications will be evaluated by Environment Canada for compatibility with the objectives and the research priorities of GLURF. The peer review of the research proposals passing the initial screening will be co-ordinated by a National Evaluation Committee composed of experts appointed by both Environment Canada and NSERC. The deadline for first year applications was November 1990 and the first awards will be granted in February, 1991.

APPENDIX ONE

Table of responses to the recommendations from the FOURTH BIENNIAL REPORT of the International Joint Commission, the FIFTH BIENNIAL REPORT of the International Joint Commission, and the International Joint Commission/Great Lakes Fishery Commission's Report: EXOTIC SPECIES AND THE SHIPPING INDUSTRY: THE GREAT LAKES-ST. LAWRENCE ECOSYSTEM AT RISK (SEPTEMBER, 1990)

I. Fourth Biennial Report of the International Joint Commission

A. Institutional Arrangements and Programs for Ensuring Progress under the Agreement.

Eutrophication

Recommendation 1

The Parties and jurisdictions undertake studies to determine the levels of nitrogen compounds which endanger the health of humans and livestock, and consider programs to address this emerging problem if the current trend of increasing levels of nitrogen compounds continues. (4th, p. 12)

Response 1

The Ontario Ministry of Agriculture and Food initiated the "Partners in Nitrogen Studies" in 1990 to establish an improved system for nitrogen recommendations to ensure nitrogen fertilizer which will provide an economic response while minimizing nitrate transport out of the root zone into the groundwater.

National Health and Welfare has recently completed an evaluation of nitrates in drinking water and has prepared a new guideline.

Introduction of Non-Native Species

Recommendation 2

The Parties take steps to prevent the further introduction, particularly the unplanned introduction, of exotic life forms into the Great Lakes ecosystem. (4th, p. 15)

Response 2

As a result of the International Joint Commission/Great Lakes Fishery Commission report on Exotic Species (September, 1990), the Department of Fisheries and Oceans, the Department of Transport and Environment Canada co-operated to fund a $250 thousand ballast water contract to Canadian and U.S. researchers. The contract sought to quantify the rate of voluntary compliance of ships entering the Great Lakes. A further objective was to determine the possibility for more exotic species entering the ecosystem as a result of foreign ships exchanging their ballast in the Great Lakes. The study is expected to be completed by mid 1991. Please refer to Section III. Response of the Canadian Government to the GLFC/IJC Report entitled **Exotic Species and the Shipping Industry.**

Coastal Wetlands

Recommendation 3

The Parties and jurisdictions increase efforts to rehabilitate, protect and preserve Great Lakes coastal wetlands and to strengthen and initiate programs which reverse wetland loss. (4th, p. 15)

Response 3

Substantive programs are currently in place which address efforts to rehabilitate, protect and preserve Great Lakes coastal wetlands and reverse wetland loss using appropriate legislation.

Major initiatives include the Ministry of Natural Resources' "Wetlands Management Program", Environment Canada's "Wetlands at Risk" Project, Department of Fisheries and Oceans' use of the Fisheries Act and the Policy for the Management of Fish Habitat (1986).

Another multi-sectoral initiative is the North American Waterfowl Management Program which is intended to protect vast areas of wetlands and habitat essential to migratory waterfowl in Canada and the United States.

The 1987 Protocol Amending the 1978 Great Lakes Water Quality Agreement

Recommendation 4

The Parties, in conjunction with the jurisdictions, develop and implement a Binational Toxics Management Strategy for the Great Lakes Basin Ecosystem to guide Canadian and United States domestic initiatives and to ensure that a more co-operative and co-ordinated approach is taken in response to the commitments made under the Protocol. (4th, p. 18)

Response 4

The Governors of the eight Great Lakes States signed a Memorandum of Understanding on the Control of Toxic Substances in 1986. Quebec and Ontario signed the Memorandum in June 1988. The Toxic Substances Control Agreement calls for the establishment of a framework for co-ordinated regional action to control toxic substances.

The Integrated Atmospheric Deposition Network Implementation Plan, signed by the Parties on June 14, 1990, is a very significant bilateral step taken in a co-operative and co-ordinated way to address the air toxics requirements in Annex 15 of the 1987 Protocol.

Environmental Legislation

Recommendation

The Commission calls attention of the Parties to the provisions of Article V of the Agreement which states: "Water quality standards and other regulatory requirements of the Parties shall be consistent with the achievement of the General and Specific Objectives. The Parties shall use their best efforts to ensure that water quality standards and other regulatory requirements of the State and Provincial Governments shall similarly be consistent with the achievements of these objectives." (4th, p. 19)

Response

The Binational Objective Development Committee is developing a protocol for evaluation and recommendation to the Parties of water quality objectives which will apply to U.S. and Canadian waters. The regulatory requirements of the Ontario Ministry of the Environment will be consistent with the attainment of these objectives.

Control of Point Sources of Pollution

Recommendation 5

The Parties and jurisdictions develop appropriate measures for reporting and assessing point source performance in relation to the Great Lakes Water Quality Agreement. (4th, p. 20)

Response 5

The Ontario Ministry of the Environment (MOE) reports on both Industrial and Municipal Direct Discharges on an annual basis. The Municipal Discharge Report provides a comprehensive summary of the flow and monthly performance of all Sewage Treatment Plants (STPs) in Ontario. Three parameters - Biochemical Oxygen Demand, Total Suspended Solids and Total Phosphorus - are assessed and compared to the MOE Sewage Effluent Guidelines defined in Policy 08-01 and 08-04. The 1988 Municipal Discharge Report also assessed a large portion of STPs against the effluent limits stipulated in their Certificates of Approval.

The Industrial Discharge Report provides average monthly effluent flow and loads discharged by source, actual loadings versus effluent limits on a monthly and annual basis, tables of remedial actions for sources not meeting limit criteria and a table of new MOE enforcement actions. In addition to the two monitoring programs, in 1988 the MISA program started sampling nine sectors for persistent toxic substances.

Environment Canada also routinely publishes (every two to three years) Sector Status Reports on the major industry sectors regulated under the Fisheries Act (e.g. pulp and paper, mining, petroleum refineries) to gauge the progress industries make towards meeting the regulations/guidelines effluent limits.

Recommendation 6

The Parties and jurisdictions intensify efforts to ensure compliance of municipal waste treatment facilities with the 1 mg/L effluent concentration of total phosphorus and report compliance on a monthly basis. (4th, p. 21)

Response 6

The Ontario Ministry of the Environment reports Sewage Treatment Plant discharges including total phosphorus on a monthly basis. Compliance limits for effluent concentrations are still set to 1 mg/L on an annual basis. The rate of compliance has improved from 53% in 1987 for those plants over 4546 cubic metres per day to 63% in 1988 and 66% in 1989. This improvement in the rate of compliance has occurred despite increases in STP effluent volumes discharged to Lake Erie and Ontario basins in the same period. Work is being carried out to revise the phosphorus compliance basis to make the policy consistent with current assessment practices.

In areas that have limited receiving assimilative capacity (i.e. the Grand River) STP expansions are restricted to the phosphorus loads of the pre-expansion facility.

Recommendation 7

The Parties and jurisdictions accelerate programs and initiatives to assure better quantification of toxic chemical loadings from municipal and industrial sources and to minimize their release. (4th, p. 21)

Response 7

The Ontario Ministry of the Environment (MOE), Environment Canada and the Municipal Engineers Association (MEA) sponsored the 'Thirty Seven Municipal Water Pollution Control Plants' study to provide information necessary to support the development of a cost-effective and practical monitoring regulation. Thirty-seven STPs were monitored including 28 secondary treatment plants, 7 primary treatment plants and 2 lagoons.

MOE is sponsoring the 'Acute and Chronic Toxicity Evaluation of Ontario STP Effluents'. The study is assessing the lethal and sublethal effluent toxicity from ten sewage treatment plants for both summer and winter conditions.

All direct discharging industrial monitoring regulations proposed under the Ontario Municipal-Industrial Strategy for Abatement (MISA) have now been promulgated. The monitoring regulations require the industrial discharger to measure the types, concentrations and total amounts of toxic substances present in their effluents. Resulting data will be used, with other information, to establish Abatement Regulations.

The Integrated Atmospheric Deposition Network will provide data on the loading of certain selected toxics to the Great Lakes. The linkage to control assumes that there is good knowledge of emissions and their transport and transformation. Currently this is not the situation. Monitoring may eventually play a role in assessing compliance with controls but the current Network has not been set up with this as an objective.

Recommendation 8

The Parties and jurisdictions provide sufficient resources and, where necessary, accelerate program development and implementation to meet the pretreatment requirements of Article VI of the Agreement. (4th, p. 22)

Response 8

The MISA Sewer Use Control Program will help eliminate the discharge of toxic contaminants and pollutants into sanitary sewers. To assist in the continued development and implementation of the program, the Ontario Ministry of the Environment is undertaking a number of projects. These projects include a Sewer Use Training Program for municipal staff, Municipal Demonstration Projects to determine the practicality of the sewer use program and the development of a Computerized Data Management System. Approximately twenty municipalities have already promulgated new sewer use by-laws which are based on the 1988 Model By-Law. These twenty municipalities represent about 60 percent of Ontario's population.

Control of Nonpoint Sources of Pollution

Recommendation 9

The Parties implement programs required to meet target loads for phosphorus and accelerating, if necessary, the current rate and priority of implementation in each jurisdiction. (4th, p. 23)

Response 9

Canada and the United States provided to the Commission a "Parties' Review of Phosphorus Control Measures" in April of 1990. This review looked at the "response" of Lakes Erie and Ontario to the entire phosphorus control program since 1972, as well as the current "loads" of total phosphorus to these Lakes. The Lakes have responded well and now are at, or near, their target concentrations of phosphorus. Reported loads are close to the targets set out in Annex 3.

The Canada-Ontario Soil and Water Environmental Enhancement Program (SWEEP) continues to encourage and support farmers to convert to conservation cropping and tillage. The effectiveness of this 30 million dollar program will be measured by the "1991 Cropping, Tillage and Land Management Practices Survey" and extrapolated to the Lake Erie Basin.

In spite of the excellent response of the Lakes, prudence dictates that existing control programs should continue but no new or accelerated efforts are needed at this time.

Recommendation 10

The Parties and jurisdictions ensure that adequate procedures are developed and funding is made available for the characterization and assessment of non-point source contaminant loadings to the Great Lakes and that appropriate controls are developed and implemented. (4th, p. 24)

Response 10

Procedures are available for the characterization and assessment of non-point source loading of contaminants to the Great Lakes.

Loading data developed from the streamflow monitoring network and the Ontario Provincial Water Quality Monitoring Network continue to provide the basis for the evaluation of loading trends of phosphorus. Detailed higher frequency data on sediment, phosphorus and other parameters, including pesticide and chemical residues, are obtained for the mouth stations of major significant tributaries in Ontario. Such data increase the precision of loading estimates and the ability to detect long term trends in loadings.

A screening survey is being conducted at the outlets of the five largest Ontario tributaries to Lake Ontario in support of the Lake Ontario Toxics Management Plan. Water, suspended sediments, and surficial bottom material are being examined for phosphorus and an extended list of many previously unmeasured organic chemicals. The results will provide estimates of mass loadings and help focus future monitoring activity.

Canada and the Province of Ontario have implemented many programs and measures to address the control of non-point source pollution in the Great Lakes Basin, including: the Food Systems 2002 Program, the Rural Beaches Program and the SWEEP Program.

Contaminated Sediments

Recommendation 11

The Parties ensure that improved mechanisms are put in place for the timely reporting of accurate data and statistics on dredging activities to enable maintenance of the Dredging Register called for under Annex 7 of the Agreement. (4th, p. 25)

Response 11

The 1980-1984 Dredging Register was released by Canada and the United States in September, 1990. Canada has compiled Canadian dredging data for the 1985-1989 Register. Meetings are planned between Canada and the United States to discuss mechanisms for more timely reporting of dredging data. Canada and Ontario will continue to maintain the Dredging Register in the future.

Recommendation 12

The Parties, in co-operation with the jurisdictions, accelerate the development of programs related to research, development and demonstration, and implementation of remediation technologies and ensure that adequate resources are made available to meet the commitments made with respect to managing contaminated sediments in the Great Lakes Basin Ecosystem. (4th, p. 26)

Response 12

Additional funds have been made available through the Great Lakes Action Plan (GLAP) to ensure that programs related to remediation techniques are adequately financed. The Cleanup Fund is one component of the GLAP that supports programs on contaminated sediment remediation and assessment. Potential projects are based on priorities in selected areas of federal jurisdiction reflected in Remedial Action Plans for particular Areas of Concern.

Restoration of Areas of Concern

Recommendation 13

The Parties ensure that each of the jurisdictions establish appropriate timetables to develop Remedial Action Plans in accordance with the requirements of Annex 2 and identify achievable intermediate goals or milestones as tangible measures of progress to complete restoration. (4th, p. 27)

Response 13

As part of the Canadian Remedial Action Plan (RAP) process, timetables for RAP development have been set. These timetables include milestones (i.e. the acceptance of water use goals for restoration). In addition, in compliance with the Stage II requirements under the Canada-U.S. Great Lakes Water Quality Agreement, delisting criteria will be specified along with a monitoring and surveillance plan which will measure progress in restoring impaired uses.

Recommendation 14

The Parties, in co-operation with the jurisdictions,

(a) continue to focus priority attention on development and implementation of Remedial Action Plans for the 42 currently identified Areas of Concern.

(b) develop procedures for listing and delisting Areas of Concern, and for measuring progress with respect to restoring Areas of Concern.

(c) identify and designate those locations in the Great Lakes basin which qualify as Areas of Concern based on these criteria. (4th, p. 27)

Response 14

(a) Canada and Ontario continue to provide high priority to the development and implementation of Remedial Action Plans. Overall resource levels accorded to RAP development have been significantly increased.

(b) Canada and Ontario have prepared draft principles for the development of delisting criteria to be included as part of Canada's Stage II documentation. As part of these guidelines, provision is made for consulting the public in the development of the site specific delisting criteria.

(c) To date, existing monitoring and surveillance programs have not indicated additional Canadian areas that could qualify for the Area of Concern designation. Canada and Ontario continue to evaluate all data collected through the Canada-Ontario Agreement Monitoring and Surveillance Subcommittee.

Surveillance and Monitoring

Great Lakes International Surveillance Plan

Recommendation 15

The Parties, in co-operation with the jurisdictions,

(a) continue to develop and implement joint surveillance and monitoring programs which are compatible with the

Response 15

Canada and Ontario co-ordinate their surveillance and monitoring activities through the Canada-Ontario Agreement (COA). The COA is directly responsive to the requirements of the Canada/U.S. Agreement including the recognition of the Great Lakes International Surveillance Plan (GLISP) as the "model" for the Parties' surveillance programs. Canada and Ontario have recognized that the current GLISP is the

Great Lakes International Surveillance Plan;

(b) identify current monitoring and surveillance activities that are particularly important to information needs under the Agreement, and ensure that these activities are supported in the common interests of both countries;

(c) consider the development and designation of specific Agreement core monitoring networks as international monitoring networks;

(d) agree on consultation procedures to be followed prior to reaching decisions on the reduction or elimination of activities identified or networks designated under the above. (4th, pp. 29-30)

"cadillac" version of what is "sufficient and necessary to meet Agreement requirements". Given this, the GLISP has been implemented within the restraint of the fiscal resources available to do the job. This essentially has meant that most requirements have been implemented, but perhaps not to the full extent outlined in the GLISP.

With the more explicit division of responsibilities between the Commission and the Parties under the 1987 Protocol, Canada and Ontario have recently taken steps with U.S. colleagues to identify major "core" programs which both sides agree are mandatory to report adequately on the "State of the Lakes". The most recent example of this is the Integrated Atmospheric Deposition Network developed and currently being implemented by the Parties. In addition, an inventory process is being developed to permit an assessment of accountability in implementing the GLISP. This mechanism will also ensure that core programs are not unilaterally cut by either Party without prior consultation.

Notwithstanding the above, Canada and Ontario are also aware that the Commission itself has some reservations with respect to the adequacy of the current GLISP to address Agreement needs as perceived by the Commission. In this regard, Canada and Ontario anxiously await the recommendations of the Commission's Data and Information Needs Task Force. The Parties also await the response to their Memorandum of November 30, 1989, requesting the Commission to have its Water Quality Board define more explicitly its data needs from surveillance and monitoring programs.

The Ministry of the Environment is complying with GLISP requirements primarily in tributary monitoring and long term biomonitoring. Equivalent or better methods for nearshore surveillance and monitoring are being pursued as part of the Remedial Action Plan program.

Finally, Canada and Ontario anxiously await the recommendations of the Air Advisory Board's Integrated Monitoring Task Force so that they may be better able to address, in consultation with U.S. colleagues, the core monitoring requirements in the context of the "international monitoring networks" mentioned by the Commission in this recommendation.

Integrated Monitoring

Recommendation 16

The Parties and jurisdictions work co-operatively to make existing monitoring sites more multi-functional and to develop new integrated monitoring sites as part of their joint monitoring and surveillance program. (4th, p. 30)

Response 16

The Master Site at Point Petre is an operational example of such a site which has been set up under the Integrated Atmospheric Deposition Network. A second Canadian Master Site is currently being selected along Lake Huron and is expected to be operational by January, 1992.

Recommendation 17

The Parties implement programs to permit retrospective analysis of environmental problems, including specimen banking for biological tissue and sediment, as an integral part of their joint monitoring and surveillance program. (4th, p. 30)

Response 17

The Department of Fisheries and Oceans has operated a Great Lakes Fish Tissue Archive for the retrospective analysis of contaminants since 1977. The program has focused on the various long term storage techniques to maintain sample integrity for future analysis of recently identified contaminants in the Great Lakes Basin. Currently an application has been made to the Green Plan to intensify the scope of retrospective analysis and expand the archive to include a wider range of samples.

National Health and Welfare has taken steps to construct a human tissue bank facility planned for full operation by 1993/94. Personal history questionnaires, sampling protocols, minimum sample sizes and a basin-wide human tissue sampling strategy have been drafted.

A series of reference stations (40-50 per lake) was used to collect surficial sediments from 1980 through 1983 in Lakes Ontario, Erie, Huron and Superior. This material was freeze dried and remains stored in a sediment bank at the National Water Research Institute in Burlington, Ontario.

Atmospheric Monitoring

Recommendation 18

The Parties consider the adoption of an 'atmospheric region of influence' in their planning and design of activities under Annex 15 of the Agreement. (4th, p. 32)

Response 18

The Integrated Atmospheric Deposition Network is intended to determine the mass loading of specified chemicals to each lake but it is not felt to be feasible - even with a greatly enlarged network - to identify source regions. This might be undertaken as an additional activity under Annex 15 or approached as a continental/global scale project.

Groundwater

Recommendation 19

The Parties and jurisdictions ensure that groundwater monitoring and surveillance activities are, to the extent practical, incorporated within their integrated monitoring strategies and programs. (4th, p. 32)

Response 19

The governments of both Canada and Ontario are involved in the mapping of hydrogeological conditions in the vicinity of existing and potential sources of contaminated groundwater affecting the Great Lakes. Specific locations of interest are the Niagara Frontier and the Sarnia area. It should be noted that groundwater monitoring tends to be 'site specific' rather than incorporated into more general monitoring and surveillance strategies.

Radioactivity

Recommendation 20

The Parties institute the Water Quality Board's recommended monitoring protocol, develop the capacity for intensive monitoring of atmospheric, aquatic and biological components following every unscheduled release of radioactivity and that information resulting from these monitoring activities be communicated to the Commission. (4th, p. 33)

Response 20

The governments of both Canada and Ontario are involved in monitoring releases from Canadian nuclear facilities on the Great Lakes.

As part of their licensing requirements, nuclear facilities must report routine and accidental releases of radioactivity to the Atomic Energy Control Board (AECB). Releases exceeding the operating licence limits are reported to the AECB within 24 hours of detection.

Environment Canada is undertaking work to ensure that nuclear facilities and other sources of radioactive contamination are controlled in a manner that meets the broad objectives of the Lake Ontario Toxics Management Plan and the Great Lakes Water Quality Agreement. Lake Ontario has the greatest number of nuclear facilities along its shores and has been identified in past studies as having levels of radioactivity which result in the highest dose commitment of the Great Lakes. Environment Canada has initiated a project entitled "Radioactivity - Lake Ontario". This project will involve open lake monitoring (water, sediment and biota), compilation of available information on sources of radioactivity loading to Lake Ontario, and impact assessment modelling.

National Health and Welfare carries out comprehensive routine monitoring of radiological contamination in the Great Lakes Basin and the St. Lawrence River Basin. A total of 13 water and 25 air monitoring sites are monitored near 5 nuclear reactor sites. Accidental releases outside Canada are also monitored.

The Ministry of the Environment undertakes a program to monitor the concentration of radionuclides in the environment around nuclear facilities in the province including mines and nuclear power plants. The media analyzed include discharge water, drinking water, precipitation, milk and soil.

Data Management Under the Agreement

Recommendation 21

The Parties and jurisdictions review the data required for implementation of the Agreement and develop a mechanism for ensuring that it is shipped in a timely manner and consistent with quality assurance and compatible data management requirements of Annex 11. (4th, p. 35)

Response 21

The Parties are in the process of appointing binational Quality Assurance/Quality Control Co-ordinators. A top priority for the co-ordinators will be the drafting of a Parties Quality Assurance Management Plan for Great Lakes Water Quality Programs.

Recommendation 22

The Parties develop a data management policy with clearly articulated goals that reflect specific data needs responsive to the Parties' commitments under the Agreement, and that the Parties and jurisdictions review their data management programs and ensure that they are consistent therewith. (4th, p. 35)

Response 22

Environment Canada is currently developing a data management system for the proposed federal pulp and paper regulations. This system will be expanded to cover all major industry sectors to be regulated under the Fisheries Act. The Ontario Ministry of the Environment has already developed and implemented a data management system (MIDES) for the MISA effluent monitoring regulations for nine major industrial sectors.

The Implementation Plan for the Integrated Atmospheric Deposition Network makes specific reference to the development of data management procedures. This will become a priority as the amount of data collected in support of Annex 15 grows.

B. Science and Agreement Programs

Relating Observed Pollutant Loadings to the Condition of the Great Lakes

Recommendation 23

The Parties establish the linkages between loadings, ambient concentrations and ecosystem responses, in order to stimulate various source reduction strategies and understand better their effects. (4th, p. 37)

Response 23

Environmental Effects Monitoring (EEM) is included in the proposed federal effluent regulations for the pulp and paper sector under the Fisheries Act. Pulp mills will be required to conduct effluent and receiving waters assessments to establish the linkage between loadings, ambient concentrations and ecosystem responses. Results from EEM will be used to establish more stringent site-specific effluent requirements where warranted to protect sensitive receivers.

The Integrated Atmospheric Deposition Network will provide estimates of the loadings of various specific toxic substances to the Great Lakes Basin.

Human Health

Recommendation 24

The Parties give high priority to human health considerations and support research to understand the impact on human health of chronic exposure to small amounts of toxic contamination. (4th, p. 38)

Response 24

A high priority has been placed on the effects of Great Lakes pollutants on human health. Activities initiated by National Health and Welfare under the Great Lakes Health Effects Program address the toxic effects of single chemicals and mixtures of chemicals through study of laboratory animals, wildlife population impacts and human population studies. Several major population studies are under way: one on cancer incidence and mortality; one on congenital anomalies; one on farm families; two on native and non-native persons consuming large amounts of fish and wildlife; and one joint Canadian/U.S. study of the effects of acid aerosols on the health of school-aged children. Animal studies are examining the effects of exposures to ambient

concentrations of ozone, multigenerational exposures to contaminants in fish, interactive effects of priority pollutants such as hexachlororobenzene, mercury and lead and other newly identified toxic PCB congeners. Many of these studies are being carried out in collaboration with experts from other countries. All the studies are reviewed by a public advisory committee and presented at public consultation sessions.

Considerable effort is being directed towards preparing toxicology profiles of regional air pollutants for the Detroit, Windsor, Port Huron, Sarnia Air Pollution Advisory Board to the IJC.

Health Advisories

Recommendation 25

The Parties and jurisdictions evaluate the relationships between the various sampling and calculation methods for fish advisories, and develop an appropriate method to transform the values calculated by various jurisdictions to some common basis for understanding. (4th, p. 39)

Response 25

National Health and Welfare is aware of the need for harmonization of fish advisories within the basin, and the need to transform fish tissue concentration data into a comparable data bank. Differences in philosophy and jurisprudence have made harmonization very difficult. The Binational Health Issues Committee expects to address this issue in 1991/92.

The Department of Fisheries and Oceans (DFO) is undertaking research to develop mathematical relationships which would produce estimates of concentrations of selected contaminants in fillets from whole fish concentrations. However it should be noted that DFO collects data on contaminants in whole fish to satisfy requirements under its Great Lakes surveillance responsibilities (i.e. for another purpose).

Ontario Ministry of the Environment's fish consumption advisories for sport fish and the Department of Fisheries and Oceans' fish consumption advisories for commercial fish are consistent and are both based on health guidelines developed by Health and Welfare Canada.

Since 1977, the Department of Fisheries and Oceans has undertaken extensive monitoring of contaminants at all trophic levels of the ecosystem. DFO is presently seeking to expand this program by requesting new resources under Canada's Green Plan. DFO is trying to incorporate other biological monitoring programs (e.g. tumour frequency in fish) as an approach to assessing the health of the ecosystem.

The Need for Ecosystem Benchmarks

Recommendation 26

The Parties develop a protocol for designating and protecting areas as benchmarks in the long term evaluation of ecosystem integrity and the effectiveness of remedial measures within the Great Lakes Basin Ecosystem, and designate several areas in the basin. (4th, p. 40)

Response 26

Benchmarks will be established as part of the Remedial Action Plans program to measure effectiveness of RAP implementation.

Biological Monitoring

Recommendation 27

The Parties undertake programs of biological monitoring in addition to and integrated with programs of chemical monitoring. (4th, p. 41)

Response 27-29

Canada and Ontario bring to the Commission's attention, that data on reproductive success in bird species (e.g. herring gulls, bald eagles), tumours and congenital abnormalities in fish and birds, the introduction of exotic species including the river ruffe and the zebra mussel have

Recommendation 28

The Parties agree on a set of ecological measurements to be used in biological monitoring programs to provide a basis for assessing the ecological condition of the Great Lakes ecosystem. (4th, p. 41)

Recommendation 29

The Parties and jurisdictions, in developing their monitoring programs, ensure that the programs provide adequate data to assess the ecological diversity of the Great Lakes ecosystem. (4th, p. 42)

from time to time been reported to the Commission's Surveillance Subcommittee by the Parties and, indeed, highlighted as emerging problems in the Board's report to the Commission under the "State of the Lakes". The Canadian Wildlife Service has been monitoring the levels of contaminants in the eggs of Herring Gulls breeding in the Great Lakes since the early 1970s. Canada's Department of Fisheries and Oceans has been conducting a bio-index program on Lake Ontario for several years. This program looks at food chain dynamics and energy recycling in the Lakes. In addition, there is a considerable volume of information within the research community on biological cycles, etc. The question, therefore, does not seem to be the lack of information, but where to draw the line in terms of what information to present. This is a question not only on the scope of the Water Quality Agreement but the scope of the Great Lakes International Surveillance Plan.

The Ministry of the Environment uses biomonitoring extensively in an integrated fashion with chemical monitoring. Contaminant concentrations are monitored in sport fish and juvenile fish across the Great Lakes. In addition, other biomonitors such as clams, leeches and caged fish are used. Benthic surveys are routinely conducted.

Response 27

Prior to biological monitoring becoming an integral and essential component of surveillance and monitoring, suitable biomonitors must be chosen. This implies a fundamental knowledge of life histories and food web interactions of the Great Lakes ecosystem. Research at the National Water Research Institute is being conducted on aspects of zooplankton and macroinvertebrate benthic ecology. The knowledge gained in these projects has been applied to the development of ecosystem indicators for Lake Ontario and will be used similarly for Lake Erie.

Human populations are also a component of the ecosystem. National Health and Welfare has been working with other agencies to develop biomarkers and bioindicators for human populations that can provide information on ecosystem health.

Response 28

Scientists at the National Water Research Institute are working cooperatively with the Binational Ecosystem Objectives Work Group to develop suitable ecosystem objectives for all the Lakes. Currently, objectives for Lake Ontario have been recommended and protocols for assessment are being developed. The proposed objectives include aquatic communities, wildlife, human health, habitat and stewardship. Research in Lake Erie and the review of suitable mesotrophic indicators has begun.

Information on Ecological Pathways and Trophic Levels

Recommendation 30

The Parties encourage the development of information on the cycling of nutrients and energy in the Great Lakes system and ensure that this information reflects the presence of all important trophic levels. (4th, p. 42)

Response 30

Investigations on the interactions between nutrients and contaminants have examined not only the cycling of these compounds and movement between ecosystem components, but have also examined the effects of food chain length and food web complexity on cycling and body burden. It is anticipated that the results from these studies, some of which are already available, will be used in calibrating existing management models and ultimately will be used in developing and implementing comprehensive resource management strategies in the Great Lakes.

Risk Assessment

Recommendation 31

The Parties undertake research to develop and use ecosystem damage and risk functions as a tool in the assessment and management of Great Lakes resources. (4th, p. 43)

Response 31-32

The Binational Objectives Development Committee has developed ecosystem objectives for Lake Ontario and is continuing to develop such objectives for the other Great Lakes.

The Ministry of the Environment and the Department of Fisheries and Oceans are undertaking research to assess whether contaminants in fish are related to the health of the fish. Specifically, research seeks to investigate linkages between contaminant burdens and fish reproductive success, enzyme levels and tumours.

Recommendation 32

The Parties and jurisdictions undertake specific research to assess whether contaminant levels reflected in advisories are likely to have significant impacts on other components of the Great Lakes ecosystem. (4th, p. 43)

Response 32

The Ministry of the Environment is developing contaminant level advisories to protect aquatic organisms and their predators.

Specific Objectives

Ecosystem Objectives

Recommendation 33

The Parties develop agreed upon protocols for measuring the effectiveness of and revising existing and future ecosystem objectives. (4th, p. 44)

Response 33

The Parties have formed a binational Ecosystem Objectives Work Group specifically to develop and review ecosystem objectives. Ecosystem objectives for Lake Ontario have been developed and work is continuing on the development of objectives for the other Lakes.

National Health and Welfare is developing biomarkers and bioindicators to measure the effectiveness of health-based Ecosystem Objectives.

Recommendation 34

The Parties, in undertaking further work on ecosystem indicators under the Agreement, consider predatory species of birds and mammals as candidates for ecosystem objectives. (4th, p. 44)

Response 34

The process of adopting ecosystem objectives which utilize both birds and mammals has already begun with Lake Ontario and is expected to be transferred to all of the Lakes. Predatory birds and mammals are under consideration as candidates for ecosystem objectives.

Mass Loading Objectives

Recommendation 35

The Parties encourage the development of practical and innovative means of estimating mass loadings of pollutants in sufficient detail to make informed decisions as to the relative significance of the various inputs of contaminants into the Great Lakes system. (4th, p. 45)

Response 35

The Framework for Lakewide Management Plans agreed to by the Parties on Dec. 4, 1989 commits Canada and the U.S. to utilizing the mass balance approach to collecting and analysing information on sources and fate of pollutants released to the Great Lakes. Under the Lake Ontario Toxics Management Plan fate of toxics models have been developed, and data acquisition needs are now being evaluated. A Non-Point Source Load Methodology is also under development by the Four Parties for use in Niagara River Toxics Management Plan and Lake Ontario Toxics Management Plan. The methodology will use existing data to calculate total loadings and identify data gaps.

Measurements of direct atmospheric and tributary inputs, as well as the outputs and ambient concentrations for a variety of compounds, are also being made. In addition, modelling of the unmonitored portion of these components is also being undertaken for Lake Ontario. These data and modelling information should provide the essential knowledge on the relative significance of the chemical inputs to the Lake and the options available to management for reducing the inputs of various substances.

Specific Objectives for Chemical Mixtures

Recommendation 36

The Parties, when establishing the toxicological and ecological limits associated with chemicals as single pollutants, also provide information on how these chemicals are likely to behave when mixed with other chemicals, and that the Parties increase research into methods of determining the fate of toxic chemicals in mixtures with a view to developing methods that are simpler, more reliable and more cost effective. (4th, p. 46)

Response 36

The toxicological significance for humans of mixtures of contaminants is of concern. National Health and Welfare has reviewed the available published information and has concluded there is little indication of synergism but some likelihood of additivity of effects. To further address these concerns, National Health and Welfare has initiated laboratory studies of mixtures (HCB and mercury, PAH congeners, PCB congeners, and a multigeneration chemical mixtures study) and three population studies (native and non-native consumers of Great Lakes fish and wildlife and multiple pesticide exposure of farm families). Various in vitro and in vivo tests are also being developed and tested to determine if mixtures of chemicals enhance risk of genetic alteration, cancer or reproductive anomalies.

In addition to their work on the biological effects of toxic chemical mixtures, studies on quantitative structure activity relationships (QSAR) and multi-species toxicity endpoint relationships are continuing in an effort to develop other methods for predicting the fate and effects of toxic chemical mixtures.

The Ministry of the Environment has funded research at Lakehead University on the toxicity of mixtures of chemicals.

II. Fifth Biennial Report of the International Joint Commission

Persistent Toxic Substances Threaten Human Health

Recommendation A

In general, the Parties are urged to:

"take every available action to stop the inflow of persistent toxic substances into the Great Lakes environment."

General Response A

The federal governments of Canada and the United States have agreed to develop a binational pollution prevention initiative for the Great Lakes. This will focus on reducing and/or eliminating the use, generation and discharge of persistent toxic chemicals in the Great Lakes Basin. The initiative is intended to complement, but not replace, existing regulatory and legislative mechanisms for pollution control.

The initiative will focus on the following components: the development of a comprehensive Great Lakes-St. Lawrence plan for pollution prevention; bilateral U.S.-Canada demonstration projects which highlight pollution prevention activities on both sides of the border; a proactive multi-stakeholder process for determining sectoral actions for pollution prevention; an educational strategy which will incorporate all levels of decision-making from the individual to corporations and institutions; and a community based action agenda for meaningful involvement of non-point pollution sources.

This will be an interactive process in which all sectors of society can contribute and offers a non-traditional approach to implementing the philosophy of zero discharge.

The Government of Canada agrees that sustained and relatively high level exposure to persistent toxic substances is associated with increased risks of adverse human health effects. The precise nature and extent of these risks remain unclear. It is likely that some

population groups, e.g. nursing infants and heavy consumers of contaminated fish and wildlife, are at greater risk than others because of dietary habits that result in a higher than average consumption of foods that contain undesirable substances. Other groups are at greater risk because of their greater sensitivity to the chemicals to which they are exposed, e.g. the fetus, newborns, the elderly, those already in ill health. It is the intent of the Government of Canada to work co-operatively with the Province of Ontario and the Government of the U.S. to identify those populations most at risk, to quantify the risk and to develop short term and long term strategies to reduce these risks to health.

Recommendation A1

Specifically, it is recommended that:

"the Parties complete and implement immediately a national toxic substances management strategy to provide a co-ordinated framework for accomplishing, as soon and as fully as possible, the Agreement philosophy of zero discharge."

Response A1

The Ontario Municipal-Industrial Strategy for Abatement program will systematically reduce water pollution at its source with enforceable regulations which become more stringent as abatement technology improves. The ultimate goal is the virtual elimination of persistent toxic contaminants from all dischargers into Ontario waterways.

For direct industrial dischargers there will be two series of regulations: Effluent Monitoring Regulations and Effluent Limits (Abatement) Regulations. The Monitoring Regulations require the dischargers to measure the types, concentrations and total amounts of toxic substances present in their effluents. Resulting data will be used, with other information, to establish Abatement Regulations. The end-of-pipe discharge limits will be based on Best Available Technology Economically Achievable (BATEA).

There are two regulatory components to the direct municipal dischargers program: the control of direct discharges from municipal sewage treatment plants, and the control of discharges to municipal sewers from industries (Sewer Use Control Program).

Currently all industrial sector monitoring regulations have now been promulgated. Three industrial sectors have completed a year of intensive monitoring, while the other six sectors are under way.

To standardize procedures and criteria in developing Abatement Regulations, an issues resolution process is under way to resolve key issues common to all industrial dischargers. Representation from the Ontario Ministry of the Environment (MOE), Environment Canada, the MISA Advisory Committee, industry and municipalities are participating in resolving these issues.

Costs have been estimated for municipal compliance with various proposed Sewage Treatment Plant Regulations. Discussions are being held by MOE and the Ministry of Municipal Affairs on the affordability of the proposed regulation. Possible strategies for assisting in its implementation are also being considered. The MISA Sewer Use Control Program will help eliminate the discharge of toxic contaminants and pollutants into sanitary sewers. To assist in the continued development and implementation of the program, the Ontario Ministry of the Environment is undertaking a number of projects. These projects include a Sewer Use Training Program for municipal staff, Municipal Demonstration Projects to determine the practicality of the sewer use program and the development of a Computerized Data Management System. Approximately twenty municipalities have already promulgated new sewer use by-laws which are based on the 1988 Model By-Law. These twenty municipalities represent about 60 per cent of Ontario's population.

The Environmental Protection Branch of Environment Canada is working strenuously towards controlling and reducing Great Lakes contamination. Specific regulatory initiatives being developed in the coming year aimed at achieving these goals include: Dioxins and Furans Release in Pulp & Paper Mills' Effluents Regulations; New Substances Notification Regulations for Polymers and Chemicals; Contaminated Fuel Regulations; Export and Import of Hazardous

Waste Regulations. As well, other regulations already in force are being strengthened, including: Pulp and Paper Effluent Regulations, Vinyl Chloride Regulations, Secondary Lead Smelter Regulations; Chlorobiphenyl Regulations; and further down the road the Metal Mining Liquid Effluent Regulations and Chlor-Alkali Mercury release Regulations.

The Integrated Atmospheric Deposition Monitoring Network has been established to measure loadings. It will be necessary to support control programs with monitoring tailored to assessing specific sites.

Recommendation A2

"the Parties and all levels of government, including local authorities, co-operatively develop and implement appropriate legislation, standards and/or other regulatory measures that will give enforceable effect to the principles and objectives of the Agreement on a basin-wide basis."

Response A2

See Response to 5th Biennial, Recommendation A1.

National Health and Welfare has been developing a National Drinking Water Safety Act to ensure uniform quality of drinking water for all Canadians. Within the Great Lakes Basin, native peoples' drinking water supplies will be monitored under this legislation.

Recommendation A3

"additional review and co-ordination measures be put into effect to ensure other legislation and/or regulations presently in place that affect matters relevant to the Great Lakes environment - or those enacted in the future - are not inconsistent with Agreement Objectives."

Response A3

See Response to 5th Biennial, Recommendation A1.

Recommendation A4

"the measures pursuant to the foregoing include provisions for initiation, implementation and co-ordination of action at all levels of government to enforce the enacted laws and/or regulations."

Response A4

See Response to 5th Biennial, Recommendation A1.

Recommendation A5

"the Parties strengthen the principle of reverse onus in policies and programs concerned with the introduction of new chemicals, through appropriate legislation and/or regulations that include mandatory pretesting prior to approval and use."

Response A5

Environment Canada is currently finalizing the Domestic Substances List (DSL) called for by the Canadian Environmental Protection Act (CEPA). The list will specify substances already in use in Canada that are exempt from notification and assessment under the new substances provisions of the Act. Substances that are not on the DSL, however, will require notification and assessment before they can be manufactured in or imported into Canada. Notification information required will be prescribed by regulation and will include physical, chemical, and toxicity data.

Recommendation A6

"the Parties, in their next biennial reports to the Commission pursuant to Annex 12:

Response A6

Both Environment Canada and the Ontario Ministry of the Environment are working towards establishing effluent limitations for the critical pollutants that are related to point source discharges (i.e., mercury, lead, dioxins, and furans). The proposed federal

*report on the extent to which discharges of 11 critical pollutants previously identified with the Great Lakes Water Quality Board - and known to have serious detrimental effects on living organisms - have been explicitly considered in the issuance of National Pollutant Discharge Elimination System (NPDES) permits and control orders.
*assure the Commission and the public that no municipal, industrial or combined sewer overflow discharges because of these substances are or will ever be permitted.
*assess and report on the extent to which these 11 substances are used, stored and released in the basin by non-point rural and urban sources, including landfills and ground-water, and the measures being taken to prevent their further release into the Great Lakes from these sources
*report on the extent to which monitoring is in place to confirm that discharges of these chemicals are not occurring."

regulation under CEPA will result in the virtual elimination of dioxins and furans from mills using chlorine bleaching processes. Mercury in effluent from the only chlor-alkali mercury facility in the Great Lakes Basin (ICI, Cornwall) is regulated under the Fisheries Act Effluent Regulation. Ontario's MISA program has completed the voluntary comprehensive 'pre-regulation monitoring program' and is completing the one-year effluent Monitoring Regulation program for nine industry sectors. This program will generate the most comprehensive toxics database for the development of effluent limits by 1992.

The Ministry of the Environment is currently developing a combined sewer overflow policy to limit the extent of overflows and establishing their required treatment.

Recommendation A7

"the parties designate Lake Superior as a demonstration area where no point source discharge of any persistent toxic substance will be permitted. This recommendation should not prejudice or delay the implementation of our other recommendations."

Response A7

Environment Canada, the Ontario Ministry of the Environment and the U.S. EPA are discussing initiatives to address the IJC's recommendation of using Lake Superior as a model for zero discharge.

In Canada's Green Plan, virtual elimination has been adopted as a national goal. To achieve zero discharge, the Green Plan commits Canada to work with the United States on the development of a bilateral action plan for comprehensive pollution prevention in the Great Lakes and St. Lawrence River Basin. The Government of Canada will also commit funding for technology demonstration and community education projects to support the pollution prevention action plan.

Recommendation A8

"The Parties sponsor and fund research projects to:
*replicate and expand on studies which demonstrate relationships between chemical exposure and human health in the Great Lakes Basin and elsewhere;

*identify other exposed populations and biological species and investigate the effects of chemical exposures on them."

Response A8

In 1989, the Government of Canada committed $20 million over five years to the Great Lakes Health Effects Program. This program is dedicated to public consultation and the development of projects with short term response times that address the relationship between chemical exposure and human health. Projects have been detailed in other responses to the recommendations of the 4th and 5th Biennial Reports.

B: Implementing the Agreement at the State, Provincial and Local Levels

Recommendation B

The second general recommendation is:
"all levels of government accept, and encourage others to accept, their responsibility to implement the Great Lakes Water Quality Agreement, and give priority to actions that contribute to the protection and restoration of the Great Lakes Basin Ecosystem."

General Response B

The federal and provincial governments, through voluntary program initiatives (e.g. the Pollution Prevention Initiative), legislative initiatives (e.g. MISA, CEPA) and financial initiatives are encouraging municipalities and private industry to comply with environmental objectives. More specifically, within the Canadian Great Lakes Basin, these initiatives encourage municipalities and industries to accept their responsibility to implement the Great Lakes Water Quality Agreement.

Recommendation B1

More specifically, it is recommended that:
"the Parties and jurisdictions fully inform and involve local governments with respect to their potential contribution towards achieving the Purpose and Objectives of the Agreement, and local governments accept responsibility to assist in the implementation of the Agreement."

Response B1

The significance of municipalities, not only as stakeholders, but also as partners in the implementation of the Agreement, is reflected in their participation on various Great Lakes Remedial Action Plan Teams and Public Advisory Committees. Municipal representation is also sought in the development of regulations under MISA, Ontario's Municipal-Industrial Strategy for Abatement, designed to reduce persistent toxic discharges to the Great Lakes. The Province of Ontario also provides financial support to municipalities toward the development of pollution control plans and implementation of control measures to reduce storm and Combined Sewer Overflows to the Great Lakes.

Recommendation B2

"the Parties and jurisdictions review and strengthen Great Lakes fish consumption advisories as necessary, and re-evaluate stocking programs for those fish which pose a threat to the health of animals and humans when consumed."

Response B2

The Ontario Ministry of the Environment and the Ontario Ministry of Natural Resources have expanded the list of contaminants being tested in sport fish to include PAHs, chlorinated phenols and chlorinated benzenes. This information will assist Health and Welfare Canada in setting consumption guidelines for these contaminants, if required.

Recommendation B3

"the Parties prepare and urge the use of a comprehensive public information and education program."

Response B3

On an ongoing basis, both Environment Canada and the Ontario Ministry of the Environment will continue to promote and produce Great Lakes public information materials. Some of these materials will be produced in conjunction with other federal departments and provincial ministries. Environment Canada has produced a new Great Lakes fact sheet, **Toward a Healthy Great Lakes - St. Lawrence Ecosystem - Clean Waters.**

A binational Great Lakes Information Network has also been structured, including representatives from the Great Lakes states, federal and provincial governments and non-governmental organizations. The Network sponsors an Annual Great Lakes Communications Workshop, co-ordinated by the Great Lakes Commission. The focus of this Network is to promote informal participation and information sharing in the Great Lakes Information Community.

National Health and Welfare has prepared a detailed communication and public consultation strategy. The strategy has been built on a public consultation process and emphasizes partnership. National Health and Welfare is now developing educational aids and actively supporting public information meetings

in communities around the basin to hear and respond to public concerns. It has co-sponsored a basin-wide educators teleconference with the IJC.

Recommendation B4

"the Great Lakes states and provinces incorporate the Great Lakes ecosystem as a priority topic in existing school curricula."

Response B4

The federal and provincial governments will continue to produce public education and information materials. At this time these materials include the Great Lakes Atlas (produced jointly with the U.S. EPA), The Report of the Parties, RAP newsletters and various Great Lakes fact sheets. Working with the new Federal Directorate for Environmental Education, the COA Information Committee and Environment Canada's Great Lakes Environment Office will promote and assist with the development of educational materials on Great Lakes issues. The Directorate's mandate includes the co-ordination of education proposals within the school curricula. Additional Great Lakes education materials are available from outside agencies and organizations.

Recommendation B5

"jurisdictions use the Great Lakes Areas of Concern as focal points for the development of educational programs and materials."

Response B5

The Canada-Ontario Agreement RAP Steering Committee has prepared a new Remedial Action Plan brochure to inform the public about how these plans will help to improve water quality in seventeen designated Areas of Concern on the Canadian side of the Great Lakes. The COA Information Committee will continue to assist with the production of individual Remedial Action Plan newsletters and fact sheets for distribution to the general public in Areas of Concern, as well as assist with the development of Community Public Involvement Programs.

C. Remedial Action Plans

Recommendation C

The third general recommendation is:
"the Parties give high priority to the development and implementation of RAPs, taking into account the need for public involvement throughout the process."

General Response C

In the development of the Canadian RAPs, particular attention has been given to ensuring that the public is consulted in all aspects of the RAP program.

Recommendation C1

More specifically, it is recommended that:
"the responsible Parties and jurisdictions revise all RAPs that the Commission has found do not meet Stage 1 requirements."

Response C1

Under the Canada-Ontario Agreement, Canada and Ontario have committed to providing updated and additional information in response to comments from the IJC. This additional information will be provided as part of the Stage II documentation progress reports.

Recommendation C2

"the responsible jurisdictions accelerate the preparation and submission of RAPs for the remaining Areas of Concern and provide the technical and financial resources needed for their implementation."

Response C2

Canada and Ontario view present schedules as appropriate given the requirements for technical investigations and public consultation. Where possible, RAP development is being expedited and implementation initiated prior to submission of Stage II documentation. Canada and Ontario are currently investigating resource needs and funding mechanisms to ensure a consistent implementation framework. Environment Canada's Cleanup Fund also supports RAP implementation.

Recommendation C3

"the Parties and jurisdictions encourage the participation of interested organizations and individuals throughout RAP development and implementation by sustaining community participation groups already established, and creating comparable institutional mechanisms in the other Areas of Concern."

Response C3

Under COA, Canada and Ontario have instituted a comprehensive program of public participation and information. Public Advisory Committees (i.e. stakeholder groups) have been established for 16 Areas of Concern. In addition a program wide council of Public Advisory Committees was established in 1990.

Recommendation C4

"the jurisdictions include a detailed plan for public participation as part of the Stage 1 submission of RAPs."

Response C4

Canada's Stage 1 submissions currently include a full description of public participation activities.

D. Spills: Potential for Catastrophe

Recommendation D

The fourth recommendation states: "the Parties strengthen and adopt provisions for the prevention of spills of toxic and other hazardous substances from vessels and other sources, and ensure they are prepared to deal with emergencies that may arise."

General Response D

The Federal Government's Green Plan and the report of the Public Review Panel on Tanker Safety and Marine Spills Response Capability, **Protecting Our Waters**, address those capabilities and make appropriate recommendations.

The conclusion of the Public Review Panel on Tanker Safety and Marine Spills Response Capacity is that there is strong evidence that double bottoms or hulls do limit pollution from groundings and collisions.

The Green Plan also acknowledges this evidence and states that "Sea-going tankers that bring chemical and petroleum products to this country and export them from Canadian ports represent a major potential marine threat". The government's objective is to implement measures that will result in an environmentally safer method of transporting petroleum products by water. Although no single design feature can completely eliminate accidental oil spills, the Canadian Coast Guard advised that the double hulls have the potential to prevent or significantly reduce outflows from low impact groundings or collisions. For this reason, the federal government will begin consultations with tank-ship owners and operators for phasing in this important measure.

The Coast Guard is developing standards for barges carrying oil and noxious substances and will be consulting with industry operators.

Recommendation D1

Specifically, it is recommended that: "the Parties increase pilotage requirements for all vessels carrying oil and hazardous substances in the Great Lakes."

Response D1

Pilotage in the international waters of the St. Lawrence River and the Great Lakes is a joint responsibility of Canada's Great Lakes Pilotage Authority (GLPA) and the U.S. Coast Guard. There are continuous bilateral discussions on the subject between these two entities, and the respective administrations.

The U.S. Oil Pollution Act of 1990 enacted a number of changes regarding pilotage, including a redefinition of those individuals who may serve as pilot on Undesignated Great Lakes Waters.

In April 1991, the Canadian Coast Guard plans to release its discussion paper on the issues raised in the September, 1990 report of the Public Review Panel on Tanker Safety and Marine Spills Response Capability and will begin the process of consulting with industry and the public. These consultations will form part of the first step in the

development of a comprehensive plan for implementing improvements as recommended by the Public Review Panel report. Because of their regulatory responsibilities under the Pilotage Act, all four Pilotage Authorities (Atlantic, Great Lakes, Laurentian and Pacific) are presently reviewing the Public Review Panel's report and its recommendations from the regulatory perspective.

The report of the Commissioner of Inquiry into proposed regulatory amendments by the GLPA, released by the Minister of Transport in May 1990, is currently under ministerial review.

Recommendation D2

"the Parties improve communication and tracking of all vessels carrying oil and hazardous cargoes."

Response D2

Work has begun on a comprehensive review of national requirements for vessel traffic services for high-risk and environmentally-sensitive areas. Vessel traffic services are important prevention systems and are the subject of numerous panel recommendations.

The Green Plan says that, "Over the next five years, preventative measures will be enhanced. They will include improvements to highest-priority radar and vessel traffic control facilities, electronic charting for tankers, increased inspection of vessels and increased aerial surveillance. By the end of 1991, on-board inspection of foreign-flag vessels will be increased."

Recommendation D3

"the Parties enhance the capability of the Coast Guard and other relevant agencies to respond to all spills of oil and hazardous polluting substances."

Response D3

The government accepts the conclusion of the Public Review Panel on Tanker Safety and Marine Spills Response Capability that the Canadian Coast Guard's role and responsibilities as lead agency in responding to spills must be clearly defined and strengthened through formal designation. In addition, the requirements for personnel, training and equipment to ensure strong, immediate response to pollution incidents by the Coast Guard is being carefully examined.

The Green Plan also addresses this problem and states that, "On the response side, the federal government will improve Canada's existing response capability for oil and chemical spills into coastal waters. The role and responsibilities of the Canadian Coast Guard as lead agency in responding to marine spills will be more clearly defined and strengthened.

Over the next five years, measures will be introduced to improve marine spill contingency planning, upgrade cleanup equipment, improve and expand training programs for response personnel, and increase research and development focusing on spill response techniques and technologies."

The Ontario Region of the Canadian Wildlife Service has prepared a response plan to enact in the event of an oil spill in the lower Great Lakes. Five permanent and two mobile oil cleaning stations from Ottawa to the St. Clair National Wildlife Area have been established to rehabilitate and clean oiled birds. Scaring devices will be used to control birds near oil spills.

By the end of 1993, a greater number of better equipped and better trained response crews will be in place throughout Canada.

Recommendation D4

"the Parties review the adequacy of funding for spill-related monitoring and enforcement."

Response D4

The federal government believes that Canadians have a right to adequate compensation when they are directly affected by marine pollution accidents and that the compensation regime must be improved. The government will examine the appropriate level of compensation, as well as use of the Ship Source Oil Pollution Fund and levy to finance improvements to Canada's prevention and response capability, as recommended in **Protecting Our Waters** by the Public Review Panel on Tanker Safety and Marine Spills Response Capability.

Recommendation D5

"the Parties examine the extent to which the provisions of Annexes 4,5,6,8 and 9 have been complied with, and take appropriate steps to remediate any deficiencies."

Response D5

There are regular annual meetings between the Canadian and U.S. Coast Guards, where progress towards the achievement of the objectives of Annexes 4, 5, 6, 8, and 9 of the Agreement is reviewed. The results of these meetings form the basis of a report which is submitted to the IJC.

E. The Parties' Response to the 5th Biennial Report

Recommendation E

The fifth recommendation states: "in order for the Commission to better assist the Parties in implementing the Agreement, the Parties should respond to the Commission's recommendations following every other semi-annual meeting of the Parties. This response should include the status with respect to implementation of these recommendations or the reasons why a delay has occurred or action has not been taken."

General Response E

This **Second Report of Canada** fulfils this reporting requirement for the period January 1, 1989 to December 31, 1990. The Parties will be establishing a more formal process for delivery of Agreement obligations, including reporting on progress towards implementation. The Commission can expect more regular reports.

III. Response of the Canadian Government to the September 1990 International Joint Commission/Great Lakes Fishery Commission Report Entitled "Exotic Species and the Shipping Industry: The Great Lakes-St. Lawrence Ecosystem at Risk"

Recommendation 1

- The United States and Canada require all oceangoing ships to exchange their ballast waters in mid-ocean, before entering the Great Lakes or connected fresh and brackish waters. In those instances when mid-ocean exchange proves inappropriate for safety or other reasons, ballast water must not be discharged unless there has been previous environmentally safe exchange or treatment to remove or destroy all organisms capable of surviving in the waters of the Great Lakes ecosystem;

Response 1

The current Canadian Coast Guard system of ballast control guidelines requests that ships bound for the Great Lakes exchange ballast water at sea. Due to safety and operational reasons and the current absence of an environmentally acceptable alternative for ships unable to comply with 'at sea' exchange, regulations are not presently deemed to be practicable. Non-complying ships are being requested to exchange ballast in the St. Lawrence River, prior to entry into the Lakes.

Recommendation 2

- the United States and Canada, through their Coast Guards and other responsible agencies, co-ordinate their ballast water exchange and treatment programs as fully as possible for purposes of standardization, monitoring and enforcement;

Response 2

Preliminary discussions have been held between the Canadian and United States Coast Guards, aimed at developing an integrated set of ballast exchange guidelines for use during the 1991 shipping season. For the longer term, a safe, compatible, and environmentally acceptable regulatory approach is being investigated by both countries.

Recommendation 3

- the United States and Canada ensure, in co-operation witH shipping and other interests, that a major applied research and development program is established and co-ordinated that devises and tests improved measures for the exchange and or treatment of ballast water; and

Response 3

Both the Canadian and the United States Coast Guards plan appropriate Research and Development projects to seek effective means of treating or retaining ballast water in ships' tanks, as a possible precursor to introduction of regulatory controls.

Recommendation 4

- the Governments of the United States and Canada work together to foster and encourage long term strategic research on all dimensions of the exotic species problem.

Response 4

As a result of the IJC/GLFC report on Exotic Species (September, 1990), the Department of Fisheries and Oceans, the Department of Transport and Environment Canada co-operated to fund a $250,000 ballast water contract with Canadian and U.S. researchers. The contract sought to quantify the rate of voluntary compliance on ballast exchange of ships entering the Great Lakes. A further objective was to determine the possibility of more exotic species invading the ecosystem as a result of foreign ships exchanging their ballast in the Great Lakes. The study is expected to be completed by mid 1991.

Subject to availability of the necessary funding, both countries will continue to work collaboratively in the application of research and development projects to the full range of exotic species problems.

Recommendation 5

- Canada and the United States instruct their national delegations to the Internation Maritime Organization of the United Nations to augment and strengthen existing conventions, codes and processes in order to:
  - establish the significance of the global - though largely unrecognized - problem of shipborne introductions;
  - assist in the development of standardized policies to address ballast transfers; and
  - provide leadership and expertise for a co-ordinated exploration of opportunities to design new vessels and retrofit existing vessels to maximize effectiveness, ecological acceptability, occupational safety, and cost effectiveness of ballast water exchange and treatment practices.

Response 5

At the 30th Session of the Marine Environment Protection Committee (MEPC) of the International Maritime Organization, a draft MEPC resolution and an accompanying set of international ballast water control guidelines was developed by a working group, which included representatives of Canada and the United States. The developed material will be circulated intersessionally to member states, with a view to its adoption by MEPC at its 31st Session in July 1991.

APPENDIX TWO
Government Contact List

THIS APPENDIX PROVIDES CONTACT NAMES LISTED BY ANNEX AND INCLUDES THE ADDRESSES AND PHONE NUMBERS OF THE FEDERAL AND/ OR PROVINCIAL REPRESENTATIVES WHERE APPROPRIATE. **PLEASE REFER TO THE GOVERNMENT CONTACT LIST IN APPENDIX THREE OF THE *ISSUES OVERVIEW* FOR INFORMATION ABOUT SPECIFIC PROGRAMS OR ISSUES.**

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ANNEX 5: DISCHARGES OF VESSEL WASTES
ANNEX 6: REVIEW OF POLLUTION FROM SHIPPING SOURCES
ANNEX 8: DISCHARGES FROM ONSHORE AND OFFSHORE FACILITIES
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APPENDIX THREE
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